SURVIVING THE RIDE

Steve Camp and Helmoed-Römer Heitman

A PICTORIAL HISTORY OF SOUTH AFRICAN-MANUFACTURED MINE-PROTECTED VEHICLES

SURVIVING THE RIDE

A PICTORIAL HISTORY OF SOUTH AFRICAN-MANUFACTURED MINE-PROTECTED VEHICLES

Steve Camp and Helmoed-Römer Heitman

30° South Publishers

Contents page – When a South African battalion in the DRC was redeployed from Kindu to Goma, it needed to move some protected vehicles quickly, but faced the twin problem of poor roads and Goma's airport being partly closed by lava. So the first Casspirs were moved by a Soviet Mi-26 helicopter.

Acknowledgements page – A Buffel escorting a convoy of civilian vehicles in the operational area of the then South West Africa.

Authors' note page – A convoy of Casspirs on operational deployment in the former South West Africa.

Published in 2014 by:
30º South Publishers (Pty) Ltd
16 Ivy Rd, Pinetown, South Africa, 3610

www.30degreessouth.co.za
info@30degreessouth.co.za

ISBN 978-1-928211-17-4

ebook 978-1-928211-53-2

Copyright © Steve Camp and Helmoed-Römer Heitman, 2014

Layout and design: Kerry Pentz – Penzil Advertising, Howick
Printed and bound: Pinetown Printers, Durban

All rights reserved. No part of this publication may be reproduced, stored, manipulated in any retrieval system, or transmitted in any mechanical,
electronic form or by any other means, without the prior written authority of the publishers, except for short extracts in media reviews. Any person who
engages in any unauthorised activity in relation to this publication shall be liable to criminal prosecution and claims for civil and criminal damages.

Dedication from Steve:

To Sally and our two children, Sarah and Stuart. Thanks for your wonderful love, encouragement and support in making this project a reality.

Dedication from Helmoed:

To Michka, Anichka and Ayden, who have been seeing even less of me than they are used to.

UNITED NATIONS
UN

Contents

Acknowledgements

Authors' note

Foreword

Chapter one: The road to MRAP

Chapter two: 1940s, South Africa's early armoured vehicle manufacturing success

Chapter three: 1970s, Pioneering mine-protected vehicles and technology

Chapter four: 1980s, Mine-protected vehicles save many lives during the height of the Border War

Chapter five: 1990s, International markets open to South African mine-protected vehicles

Chapter six: Demand for South African MRAPs in Iraq and Afghanistan

Chapter seven: South African armoured cars and infantry combat vehicles

Chapter eight: South African landmine-detection vehicles

Chapter nine: Unusual South African mine-protected vehicles

Chapter ten: Proving the concept

Chapter eleven: South African influence on MRAP vehicles internationally

Glossary

Photo credits

About the authors

R 1972

Acknowledgements

There are several individuals without whose assistance this book would have been much more challenging to produce, and we would certainly have missed some of the more obscure vehicles.

Foremost among them is Koos Joubert, one of this country's leading military vehicle experts, with more than 40 years of experience in this field, and who contributed to many of South Africa's mine-protected vehicles and to the development of other army equipment. He has plans to write his own book, for which we will definitely be the first customers!

Frans Beetge, André Coetzee, Pierre Victor, Richard Hendry, Dr Stefan Nel, himself something of a maverick in armoured vehicle design and who developed the flat-bottom mine-protection system of the Badger, and Lt-Col William Marshall, perhaps the ultimate researcher in this field, all of whom were invaluable advisors for the early decades. John Dovey and Chris Cocks for their meticulous proof-reading.

Capt Gerald Prinsloo, Nosisa Nyathi and Marlene Swanepoeffor without dedicated archivists who so carefully preserve military records and photographs, our task as historians would be that much more difficult.

Social network sites by their very nature not only keep history alive but unearth photographs and personal accounts that would not otherwise see the light of day. Keep up the good work Johan Schoeman www.warinangola.com and James Dekker www.sa-soldier.com.

We wanted a book that was beautifully laid out. Kerry Pentz you have done us proud.

To everyone else who in your own special way has contributed to our book.Col Pat Acutt, Stu Affleck, Cameron Belling, Dolf Binneman, Johannes Botha, Warren Burgess, Martin Camp, Richard Camp, Peter Camp, Dr Mark Cochlan, Lt-Col Chris Craig-Mackie, George de Beer›Craig Davel, Larry Dicks, Johan Dormehl, Ian Douglas, Okkie du Plessis, Tom Geldart, Jack Geldenhuys, Dave Gordon, Lt-Col Raymond Halls, Mike Haynes, Hennie Heymans, Michael Hill, John Keating, Lt-Col Diederik Kruger, Maj Mark Levin, Mike Lohrentz, Frans Marais, Chris Mathews, Dr Paul McGarr, Chris Morrissey, Pieter Muller, Elsette Musso, Natasha Pheiffer, Hansie Pieterse, Dr Steve Purcell, David Rees, Kevin Rhodes, Dick Stent, Paul Smith, Shane Spilsbury, Etienne Steenhuisen, Lt-Col Pat Titlestadt, Kevin Trodd, Ian Tyrer, Peter Upfold, Pete van der Spek, Nick van Vuuren, Jaco van Zyl, Alan Waddilove, Bill Williams, Lt-Col Gary Williams.

Authors' note

A few months into our book project we became acutely aware of just what a difficult task we had taken on. An enormous amount of research and development was carried out into mine-protected vehicles in South Africa during the seventies and eighties, yet very little is known about the actual details.

The companies that were involved in those pioneering years have mostly closed down since then, or their intellectual property changed hands and, sadly, many records and photographs have been lost along the way. The people involved have, 40 years on, mostly retired and moved home, some have emigrated and some have passed away.

Another challenge was that much of this development happened in great secrecy because of the UN-led international arms embargo against South Africa. There were many vehicles that never went beyond prototypes and, while through word of mouth we knew these vehicles existed, tracing their history was no mean task. Despite our best efforts, we are sure that there are still some projects and perhaps even vehicles produced in small numbers that we have been unable to identify.

Finding good photos of these vehicles, particularly photos taken in the operational area, proved very difficult, given the secrecy surrounding their development and the strictly enforced SADF policy of not allowing cameras in the operational area. Many of those that we did find were unfortunately not very good from the point of view of reproduction. Apart from these challenges, the industry itself is a very complex one, and it has been difficult trying to complete the jigsaw to establish an overall picture and time line of who was developing what and when, with many of the important details lost to the mists of time.

We have tried our best to capture this important part of South Africa's military history as accurately as possible before more of it is lost for good. In some cases, however, there was only scant information available, forcing us to make 'educated' assumptions, which in some instances may not be absolutely accurate.

It has been a fascinating journey, with some interesting discoveries along the way, and we hope we have captured this important aspect of our history adequately. South Africans can be proud of the mine-protection technology that was born in this country and which led South Africa to become a global leader in this field.

Foreword

The pictorial history of mine-protected vehicles put together by Steve Camp and Helmoed-Römer Heitman in **Surviving the Ride** is a collector's item and a must read book. Paging through the chapters, I once again realised how innovative and ingenious South African scientists, engineers, technicians, artisans and soldiers have been in conceptualising, designing, developing, testing and producing such a variety of world class mine-protected vehicles.

These vehicles have saved, and still will save, many South African and other soldiers and civilians in unconventional wars where the landmine is employed as a cheap and nasty terrorist weapon.

When the United Nations enforced the Arms Embargo on South Africa in the mid-70s, there were no allies we could turn to for support, and we had to develop our own designs and the test criteria for developing vehicles to protect soldiers and civilians from the devastating effects of anti-tank mine explosions.

Surviving the Ride is testimony to the industry's commitment to providing solutions for our soldiers. I salute the South African National Defence Force, Armscor, the defence-related industry, research laboratories and tertiary institutions for standing up to the call when it mattered most.

The capability (user's value system) normally stated for mine-protected vehicles comprises three main functional areas: mobility, survivability, and load-carrying (application). Affordability (acquisition and operating costs of a product over its entire life cycle) can be added as a fourth critical parameter. It has always been a challenge for engineers to find the right balance in design to satisfy optimally the user's requirement.

The reader will notice that a number of 'prototype' vehicles were built, which never reached production. There are a number of reasons for this:

- Unreasonable or unrealistic requirements from the user;
- Lack of decision-making by authorities despite a good design and product qualification;
- Changes in the requirements;
- Affordability of the system or simply just a poor design.

All of these prototype vehicles, however, served a purpose, as they were all classified as Engineering Development Models and soldiers and engineers could learn from these experiences to create better future designs.

For the past 43 years I have personally, in one way or another, been involved in the majority of the projects or products mentioned in this book and I am sincerely proud of being associated with this timeframe. I was fortunate to have done national service and also served as a military officer in the Citizen Force. Being exposed to front line operations and surviving mine detonations, provides one the advantage of understanding your client and the

environment in which he operates better. This advantage has now fallen away for the young, up-and-coming South Africa engineers.

DCD Protected Mobility and BAE Land Systems South Africa OMC have been the most successful with exports of mine-detection (Husky) and mine-protected (RG31) vehicles to the USA, Europe and the Middle East. Some smaller companies have also been very successful, despite international competition. With irregular, ‘asymmetric’threats on the rise, the need for these vehicles will remain.

In 1998 a joint press conference was held at the Union Buildings in Pretoria by the then president of the United States of America, Bill Clinton›and the president of South Africa, the late Nelson Mandela. President Clinton paid tribute to the South African Defence Industry by saying: “*I am very pleased that our Department of Defence has decided to purchase new South African vehicles called the Chubby. These vehicles will help us to remove mines more quickly, more safely and more efficiently.”*

What better accolade could there be?

Koos Joubert

Chapter 1

THE ROAD TO MRAP

Landmines have been around since the 13th century. Like so many other things, they were first used in Ancient China. Just like the modern mines and Improvised Explosive Devices (IEDs), they were used in both command-and pressure-detonated forms. By the 16th century, mines and explosive booby-traps akin to today's IEDs were being used in Europe, and by the wars of the 20th century they were a feature of all wars, mainly in the form of defensive minefields intended to channelise or delay the enemy.

The many guerrilla wars that followed World War II brought a different emphasis to the use of mines, guerrillas using mines to hamper movement by security forces, as part of ambushes and also to disrupt economic activity and terrorise civilians in the contested area. Such nuisance mining became a characteristic feature of the conflicts in the former Rhodesia and even more so in the former South West Africa. Some mines were also laid in South Africa's border areas in an effort to drive farmers off their land and to facilitate guerrilla infiltration from neighbouring countries.

South Africa and mine-protected vehicles

The main reason for the popularity of the landmine with guerrillas is a simple one: landmines are relatively cheap, are readily available from a supporting government or on the international black market in arms, and do not require much training to use. Add to that the fact that a guerrilla can lay a mine fairly quickly and with minimal risk of becoming engaged in combat with opposing troops. Taken together, these factors make the landmine an ideal tool of guerrilla warfare.

Most landmine victims in the north of Namibia were local civilians, travelling in cars, pick-ups and light trucks that offered no protection at all.

The increasing use of anti-tank mines for these purposes in southern Africa from 1971 onwards presented a real challenge to the former Rhodesian Army and the South African Police in Namibia's Caprivi Strip and then the South African Army on the border with Angola.

The classic sweeping with a handheld detector was too slow to be a practical means of allowing swift movement of reaction forces or keeping roads open for civilian use, and the mine-clearing systems used in conventional war – flails, ploughs and line-charges – were hardly suited to clearing extended stretches of road. Later in the conflict in northern Namibia the security forces had developed their relationship with the rural population sufficiently to receive warning of mines planted on roads, but during the latter 1970s and early 1980s that had not yet been achieved.

Tough as the Unimog was, it was not a match for a mine designed to disable a tank, and incidents like this led to the development of mine-protected vehicles, which quickly reduced mine casualties to a minimum.

The only option for both the former Rhodesian Army and the South Africans, was to develop mine-protected vehicles that could move along roads with little risk to the crews even if a mine was detonated, thus restoring mobility, and to develop mine-detection vehicles to sweep roads at a reasonable rate to allow normal civilian traffic to continue.

The first efforts were similar to those implemented in earlier conflicts: reinforcing of the floor with sandbags, conveyor-belts or sometimes mild steel plates, and sometimes adding semicircular roll cages to protect the crew in the event of a mine flipping the vehicle over. While all of this helped, none of these solutions were really effective, and certainly not when it came to double or multiple mines. The next step was to develop dedicated mine-protected vehicles, which then developed into the 'mine-resistant, ambush protected' (MRAP) vehicles of today, and specialised mine-detection vehicles.

While initial work was carried out in the former Rhodesia, often with assistance by explosives experts from the Chemical Defence Unit in South Africa, it was the South African Army and Police that laid the foundation for the vehicles we see today.

Research into vehicle mine-protection had, in fact, already begun in South Africa in 1970. This research was initiated by a letter from the office of the Commandant-General of the Defence Force which he wrote to the President of the Council for Scientific and Industrial Research (CSIR) in February of that year, asking that “some serious thought” be given to means of countering the use of mines by guerrillas. A first result was the development in early 1971, by the National Institute of Road Research, of a vehicle that “can be repaired even after a number of detonations”

In 1972 the development of mine-protected vehicles was transferred to the National Chemical Research Laboratory, later the Chemical Defence Unit, led by Dr J. de Villiers and Dr Vernon Joynt, the latter widely regarded as the father of today’s mine-protected and MRAP vehicles.

The first mine detonation involving a South African mine-protected vehicle and South African personnel, came on 16 November 1973, when a Hyena detonated a 21 kg TNT charge triggered by a switch in the track, with the charge itself buried in the centre of the road. The vehicle was destroyed, but the two passengers escaped with minor injuries – cuts on an arm and a perforated eardrum.

That set the scene:over a period of 50 months between January 1978 and March 1988 for which figures are available, only 33 soldiers and policemen died in 533 mine detonations, 90 of them involving multiple mines.

The CDU developed a range of vehicles in South Africa, of which the Casspir is the best-known, assisted the Rhodesians as well as developing vehicles for other countries, including the United States. Dr Joynt was later employed by Force Protection in the United States as their chief scientist, and was later joined by other South Africans who also carried their knowledge of these vehicles to the USA and other countries.

The Casspir provided an outstanding level of protection in a mine detonation – but not if one was sitting on the side of the hull instead of inside!

THE EFFECTS OF A MINE

The first fact to accept is that it is almost impossible to fully protect a vehicle against an anti-tank mine; after all they are intended to rip the track off a main battle tank, which is a tougher task than inflicting critical damage on a lighter vehicle. What can be done, is to protect the crew of a vehicle against the effects of a mine detonation and to design a vehicle in such a way as to allow quick repair, preferably in the field.

These two high-speed video images dearly show the shock wave moving outwards well ahead of the cloud of hot gas, itself followed by smoke and debris.

Before considering how to achieve any of that, it is necessary to understand how a mine is designed to cause damage and injury. Essentially there are three factors at work when a mine is detonated by a vehicle:

- **Flash,** which is near-instantaneous, and which can cause severe burns and can ignite flammable vapours, such as in a partly empty fuel tank, flammable fluids and particularly flammable materials. Clothing that contains plastic fibres can melt onto the wearer, which is why the navy wear mainly cotton flash-proof clothing in combat, complete with antiflash hoods and gloves. The fire-retardant overalls worn by tank crews also protects against flash.
- **Blast,** with five component effects, the shock wave itself, its shattering effect (brisance), the wave of hot gas following immediately behind the shock wave, the impetus it imparts on a vehicle, and the negative pressure blast wind that follows the detonation:
  - The shock wave travels at supersonic speeds of up to 6 900 m/sec, causing overpressures up to 690 kPa (compared to 1.72 kPa generated by a 200 km/h wind). That can deform even thick floor plates or cause them to flex suddenly and rapidly, causing injury; it can rupture welds or thin plate, entering the vehicle to cause traumatic

amputations and massive internal injuries; and can wrap itself around objects, for instance entering a vehicle if there is any gap in the hull. The effects are even worse when the shock wave is reflected by a hard surface, which can cause an amplification of up to nine times its original strength.

- The brisance or shattering effect of the blast as its energy is transferred into a hard material, can cause metal parts to shatter as the shock wave propagates through the structure of a vehicle.
- The hot gas that follows, 2 000 to 6 000° C moving at 3 000 to 4 000 m/sec, can cause fatal burns and ignite any flammable material in the vehicle.
- The impetus imparted by the expanding hot gas bubble to a vehicle can knock it over, lift it or even fling it over surprising distances. The soil and road debris carried with the gas bubble adds mass, increasing the lift or push effect. The acceleration caused by the impetus can cause serious injury, as can the impact as the vehicle lands again or falls over, and people can be thrown out, with real danger of being crushed.
- The negative pressure wave is caused when air floods back into the vacuum that is created by the outward rush of the shock wave. While this is at lower velocity, it can cause some damage and, potentially more dangerous, it can fill the vehicle with smoke, fumes and even unburned flammable gasses that a hot spot could ignite.

- **Debris** can take several forms in a mine strike:
  - The mine scatters some shrapnel and can have a metal plate or other material placed on top of it to add to the shrapnel, some of which could penetrate into the vehicle.
  - The mine blows soil and pieces of road surface upwards and outwards at between 1 300 and 3 200 m/sec, quite fast enough to blow through the bottom of a vehicle and cause injuries to occupants, or to rip open a fuel tank, creating a lethal mixture of vaporised fuel and liquid fuel that can explode and then burn.
  - If the shock wave or debris rupture the hull, pieces of hull and of the driveline can themselves become shrapnel.
  - Pieces of the vehicle hull that shatter as a result of the brisance effect can become shrapnel.
  - Loose equipment and weapons inside the vehicle will be accelerated and become dangerous ‘flying objects’ that can cause serious injury.

PROTECTING THE CREW

With the explosion causing damage and injury in several different ways, it must be addressed in respect of each if protection is to be effective:

- **Flash**. The armour envelope of a vehicle will normally protect its crew against flash and related injuries.
- **Shockwave**. Sufficient steel strength in the lower hull to prevent ruptures or deformation; careful design to avoid openings the shock wave could exploit to enter the vehicle and to ensure that side doors, hatches and windows cannot be ‘peeled’ off; careful shaping to minimise the risk of the shock wave flowing around parts of the vehicle into the crew compartment; side- or roof-mounted shock-absorbing seats with footrests, to prevent back injuries from the sudden acceleration and to prevent leg injuries from sudden floor deformation.
- **Brisance.** Careful selection of the armour steel to be hard enough to resist penetration and to keep out fragments (and rifle fire in a contact), yet resilient enough not to shatter or rupture, but to allow controlled deformation; careful selection of the steel and other materials used for vehicle components and fasteners, to avoid material likely to shatter; careful mounting of windows to avoid them shattering.

Most modern mine-protected vehicles have sidemounted, like this RG34, or roof-suspended seats to reduce the risk of back and lower limb injuries to sudden acceleration and floor deformation.

Where a mine detonation might 'peel' a window off a vehicle, a roadside IED detonation can blow a heavy armoured glass window into the crew compartment, with potential for very serious injury, so newer vehicles have externally mounted windows that cannot be blown in and are secured against being peeled off.

The V-shaped hull did not prevent this Buffet being overturned by a multiple mine, although the crew survived without serious injuries. The chassis is clearly visible, and may have provided the blast traps that caused the vehicle to overturn, although this was clearly a serious explosion – note the driver's cab tom off and lying in front of the Buffet. Note also that the hull was not ruptured.

- **Hot Gas**. As for the shock wave, the requirement is careful design to prevent the cloud of hot gas entering the vehicle.
- **Impetus**. Shaping of the hull to deflect the shockwave and the following gas cloud and debris away from the vehicle; avoiding blast traps under the hull; placing the wheels as far from the hull as possible (longer wheelbase, wider track) to keep the explosion further from the hull; ensuring that external components blow off rather than trap the shock wave, the gas cloud or debris; all to reduce the impetus that will be transferred to the vehicle by the explosion, and thereby the risk of it being thrown upwards or blown onto its side or even completely overturned. The vehicle design can also place all heavy components and the fuel and water tanks as low as possible – for instance inside the 'V' of a V-shaped hull-to move the centre of gravity as low as possible, improving stability. The newest technology is moving to hull designs that absorb the energy of the blast rather than deflect it, seeking to provide the same level of protection without the height problems. This 'flat bottom' technology is, for instance, incorporated in the Badger infantry combat vehicle.
- **Negative Pressure**. Careful roof and hatch design to prevent the low pressure inside the vehicle in the immediate wake of the explosion sucking the roof, hatches or debris into the crew compartment and injuring crew members.
- **Debris**. Armoured, carefully shaped hull to prevent mine fragments, road surface debris and soil blowing through the hull floor into the troop compartment or rupturing the fuel

tanks and creating the danger of a fuel gas explosion and fire; armour protection for any external components vulnerable to debris damage; ensuring that no internal components can blow off and injure the crew; providing secure stowage for weapons and equipment, to prevent them becoming dangerous ‘flying objects’; providing harnesses to prevent crew members being thrown around inside the vehicle or even thrown out.

OTHER ELEMENTS OF PROTECTION DESIGN CAN BE CONTRADICTORY

For instance, the greater the distance between the mine and the vehicle hull, the less the forces exerted on the vehicle and the lower the risk of hull penetration by debris; but the greater that distance, the higher the vehicle and its centre of gravity, and the lower its stability and the greater the danger of it being overturned – not to mention overturning if driven enthusiastically, as soldiers often tend to, particularly in a pursuit. On the other hand, lowering the centre of gravity to improve stability, will either bring the vehicle hull closer to the mine or require the addition of weight low down in the vehicle, for instance by increasing plate thickness or filling the tyres with water (which also increases the unsprung weight), which will make the vehicle heavier and less mobile.

A Buffel (left) and one of the Remark prototypes (right), both showing the V-shaped crew compartment. The Remark vehicle is notably larger and heavier, and the crew compartment floor is clearly higher off the ground – and further from any mines – than that of the Buffel.

This SAMIL-20 Kwêvoël, still awaiting its body, shows the clean lines of the armoured cab, designed to deflect blast and debris. The same cab design was used for all of the Kwêvoël trucks, adapted to fit the larger 5-ton SAMIL-50 and 10-ton SAMIL-100. In the documented 26 incidents in which some of these vehicles detonated a mine -three of them multiple mines – only four soldiers were injured and none killed.

Similarly, mounting the wheels far out on the corners will keep the mine's blast effects further from the vehicle, but will greatly hamper mobility by reducing the hump radius and increasing the turning circle. Also, heavier vehicles are far less vulnerable to the impetus effect of a mine explosion, but heavier vehicles are less mobile, particularly off-road.

The bottom line is that designing a properly mine-protected vehicle is not as simple as it might seem; not for nothing did it take scientists and engineers several years to develop truly effective designs like the Buffel, Casspirand Kwêvoël.

The rise of the roadside improvised explosive device (IED) has added the requirement to take similar design measures to protect the side of the vehicle against the effects of an explosion. In the first instance, this argues for turrets rather than simple open weapon mountings on the roof and, indeed, argues for a roof to prevent the shockwave and the gas cloud entering the vehicle through an open top. IED protection also requires similar

measures applied to the vehicle side as to its bottom, strengthening the side against the 'blunt' impact of the shock wave and fitting the windows onto the outside of the armoured hull rather than inside, to prevent them being blown into the vehicle and becoming lethally dangerous to the crew.

FROM BOSVARK TO MRAP

One of the first South African vehicles to apply some of these considerations was the Unimog Bosvark, essentially a standard 4x4 Unimog 416 but with a shallow-V shaped armoured steel 'bathtub' troop compartment on the back for the infantry section. This was followed by other vehicles with a V-shaped body mounted on a chassis – the Hippo and Buffel – which were better but rather too high and ungainly, and finally the monocoque-hulled Casspir and then the newer MRAP-type vehicles. All of these types and various derivatives and other vehicles are discussed in the pages that follow.

All of these measures, even the initial efforts with conveyor belting and sandbags, did help to an extent. Deflector plates mounted above the wheels were an exception, increasing the number of injuries rather than reducing them; a good illustration of why careful design and trial and error are critical to this process.

One study of former Rhodesian Army mine-incident data, carried out by Arul Ramasamy and others at the Imperial College in London, showed this very convincingly: Analysing data from 2 212 mine detonations involving 16 456 people in the vehicles affected, they found that there was a 11.4% risk of fatal injuries and a 24.7% risk of other injuries in unprotected vehicles. In the case of protected vehicles – all of them early in the development cycle and some still quite primitive – those risks dropped to 1.2% and 22.2% respectively.

More modern designs have reduced the injury risk further, by addressing shock transfer to crew members through floor plates and floor-mounted seats and better measures to keep both the shock wave and the gas cloud from reaching the crew.

The same study also came to the conclusion that the most effective means of protecting the crew of a vehicle was increasing its mass, which greatly negated the effort of impetus and the resulting injuries. But that, of course, brings mobility challenges. The next best means of protecting the crew was found to be a V-shaped hull, which moved the crew higher and further away from the blast and deflected both the blast and its debris.

Arul Ramsamy also conducted a study to determine which measures were best in reducing injuries in mine detonations, which he published in the Journal of the Royal Society. His findings were that:

- **Primary injuries**-caused by the shock wave – are best addressed by means of greater ground clearance, careful design based on gas dynamic characteristics, and the use of blast-mitigating materials.

- **Secondary injuries –** caused by mine shrapnel, soil and road debris and vehicle fragments – are best addressed by a strong armoured floor and by reducing the potential of internal fragmentation. The latter refers to the dangers of poorly stowed equipment and of interior fittings and fasteners that might shatter under the effect of brisance.
- **Tertiary injuries –** caused by vehicle acceleration and floor deformation – are best addressed by reducing the accelerations imposed on the vehicle, reducing pressure capture, a strong floor pan and crew harnesses.
- **Quaternary injuries –** caused by the thermal effects of the blast – are best addressed by the use of fire-resistant materials and fire-retardant clothing, and explosion-suppression / fire-extinguishing systems.

Finally, armies must also consider cost and particularly the cost of repair after a detonation. It is in this respect that monocoque vehicles like the Casspir have another major advantage: all of their major driveline components are mounted inside the protective envelope of the armoured hull, and are not exposed to damage by blast or debris. Some Casspirs have taken as many as seven mine detonations, been repaired in the field each time within an hour, and remained serviceable.

Peggy

Chapter

1940s, SOUTH AFRICA'S EARLY ARMOURED VEHICLE MANUFACTURING SUCCESS

2

When the South African government began to consider re-equipping the Union Defence Force, one equipment gap was a lack of armoured vehicles. Some recalled the successful use of armoured cars in South West and North Africa in World War I, and in 1938 the government funded a project to develop a local armoured car.

The outbreak of World War II lent urgency, and the first cars were delivered in 1940. With no local automotive industry, they used a Canadian Ford chassis and a 4x4 drive train from the US company Marmon-Herrington, for which they were informally named, the official designation being 'South African Reconnaissance Car'. The armour was manufactured by the Iron and Steel Corporation (ISCOR) and the cars were assembled by Dorman Long. While these vehicles looked primitive, they were successful in East and North Africa, and by 1945 more than 5 700 had been built in several variants, and development of an eight-wheeled armoured car had begun, which then stopped.

The last South African reconnaissance cars were still in service with the SA Army in the 1960s, and even later in some other armies.

The South African Reconnaissance Car

Prior to 1938, South Africa had no experience in the manufacturing of armoured vehicles. Not long before the declaration of war with Germany in September 1939, the South African Army, realising they had a severe shortage of armoured vehicles, launched an experimental programme to locally design and manufacture armoured cars. A prototype was delivered on 18 September 1939. This was designed by Germiston-based Dorman Long and based on a 3 ton 4x2 truck chassis manufactured by Ford Motor Company of Canada, with a Ford V8 engine and the drive chain from the American company, Marmon-Herrington. After extensive testing, a few modifications to the design were made, such as the shortening of the chassis.

Dorman Long was responsible for the final assembly, at its Germiston plant, of the armoured cars. More than 70 other South African companies acted as subcontractors, all having to design and build special tools and jigs to produce these components. ISCOR developed and manufactured all the armour plating from scratch. These plates were welded together, forming turrets and bodies, by the South African Railways and Harbours workshops.

MARK I

The first South African Reconnaissance Car entered production in 1940 as the Mark I (SARC Mk I). Only 135 of these two-wheel-drive MK Is were manufactured.

The SARC MK I had a long-wheel-base 4x2 configuration, with double slotted radiator doors, a ball-mounted Vickers gun in the turret and hull sides. Access was by two large doors at the rear. The headlamps were behind small square doors. After seeing combat against the Italian forces in East Africa, it was decided to confine these vehicles mostly to training and for internal security in South Africa.

SPECIFICATIONS

Only used by South African forces

Crew:	4
Dimensions:	
Length	4 877 mm
Width	1 981 mm
Height	2 362 mm
Wheel base	3 404 mm

Performance:

Top speed	72 km/h
Range	322 km

Protection Levels:

Armour	6 to 12mm
Armament	.303 Vickers LMG

Engine:

Front-mounted, water-cooled, petrol, Ford V8.

Transmission:

Manual with 4 forward and 1 reverse gear.

Suspension System:

Leaf spring, wheels steerable, front pair.

23

MARK II

The MK II had a shorter wheel base and a full 4x4 drive. It was a fairly simple but very effective vehicle. When they were manufactured and issued to the South African and British forces in North Africa, they were the only reconnaissance cars in any numbers, resulting in widespread use for many of the early Western Desert campaigns.

The South African Reconnaissance Car Mk II actually covered two slightly different vehicles, the MFF (Mobile Field Force) most of which were used by South African units and the ME (Middle East) mostly used by British and Commonwealth units and to a limited extent exported to friendly countries in Asia. The main difference was in armament and fitting of weapons. The ME had an additional fixture on the front of the turret, which could hold a Boys anti-tank rifle and a .303 Bren gun. The Vickers ball mounting on the hull was also replaced with a port that would accept a Bren gun. A total of 887 MK IIs were manufactured in both 549 MFF and 338 ME versions.

SPECIFICATIONS

Used by South African and a variety of Commonwealth forces.

Crew:	4
Dimensions:	
Length	4 877 mm
Width	1 981 mm
Height	2 362 mm
Wheel base	3 404 mm
Mass:	
Empty	5 993 kg
Performance:	
Top speed	80.5 km/h
Range	322 km
Protection Levels:	
Armour	6 to 12 mm
Armament	.55 calibre Boys AT .303 Vickers LMG
Elevation and traverse	manual
Auxiliary weapon	.303 Bren

Engine:

Petrol, water-cooled Ford V8 producing 85 hp. Location – front.

Transmission:

Manual with 4 forward and 1 reverse gear and a 2-speed transfer case.

Suspension System:

Leaf spring, wheels steerable, front pair. Tyre size – 9.75x18 self-sealing

GLAMOUR
WAGON
U.38396

MARK III

The Mark IIIs were similar to the Mark II except for a slightly shorter chassis and no double rear doors and with vastly improved armouring. To achieve this on the same chassis the body was made more compact, which also led to a shorter wheelbase. Whether produced as ME or MFF models the armament was entirely in the turret. While early Mark IIIs had an access door on each side of the crew compartment and the spare tyre mounted on the rear slope, later versions moved the tyre to the left rear side of the vehicle and added a single door to the rear to improve crew safety.

Besides improved mechanicals, attention was paid to improving the comfort of the crews in the cars. The general thickness of the armour plate remained the same at 6 mm with all forward-facing areas at a full 12 mm of protection. More than 2 000 Mark IIIs were built before production stopped in mid-1942, 2 630 Mark III MFF and 798 Mark III ME, with a further 52 vehicles converted to up-gunned cars to supply Light Aid Detachments in North Africa.

SPECIFICATIONS

Used by British and South African forces, as well as British West Africa (60 Mk III MFF), Dutch East Indies – Indonesia (49 Mk III MFF), Free French Forces in Central Africa (10 Mk III MFF) and Free French Forces in North Africa (48 Mk III ME), India (255 Mk III MFF), Malaya (175 Mk III MFF), Mozambique (6 Mk III MFF), Rhodesia (24 Mk III ME).

Crew:	3
Dimensions:	
Length	5 309 mm
Width	2 299 mm
Height	2 502 mm
Wheel base	2 985 mm
Ground clearance	279 mm
Mass:	
Loaded	5 675 kg
Performance:	
Top speed	88.5 km/h
Range	322 km
Protection Levels:	
Armour	6 to 12mm
Armament – .55 calibre Boys AT and .303 LMG (either Vickers if an MFF or Bren if an ME) in turret.	
Elevation	manual
Traverse	manual 360°
Fire Control	optical (1.92 power scope)
Auxiliary weapon	.303 Bren
Engine:	
front mounted, Ford water-cooled petrol V8 producing 95 hp (sometimes during refits this was replaced with the earlier 85 hp engine).	
Transmission:	

Manual with 4 forward and 1 reverse gear and a 2-speed transfer case.

Suspension System:

Leaf spring, wheels steerable, front pair.

No of wheels-4

Tyre size – 9.75x18 self-sealing

MARK IV

In March 1943 a completely redesigned Mk IVA entered production. It was a monocoque with a rear-mounted engine, still based on the same engine and Marmon-Herrington components. The main armament, a quick-firing 2-pounder anti-tank gun was mounted in a two-man turret. The gun used an artillery mounting as the turret was not up to the stress of a tank mantled mounting. Later production vehicles had a coaxial Browning .303 MG. An anti-aircraft Vickers or Browning MG was mounted on the turret roof. Of interest, after the war many Jordanian examples had the turret lengthened at the front and fitted with a 6-pounder (57 mm) gun, while others had the turret removed and a Vickers 2.95” mountain howitzer fitted in its place. There were 840 Mark IVAs manufactured.

SPECIFICATIONS

Used by a variety of Commonwealth forces during World War II.

Crew:	3
Dimensions:	
Length	5 525 mm
Width	2 134 mm
Height	2 286 mm
Wheel base	2 896 mm
Ground clearance	279 mm
Mass:	
Loaded	6 311 kg
Performance:	
Top speed	84 km/h
Range	579 km
Protection Levels:	
Armour – 6 to 12 mm, 4 mm under driver’s compartment.	
Armament	40 mm (2-pounder gun)
Model	QF Witwatersrand GM
Elevation	manual -5 to +20°
Traverse	manual 360° in 22 seconds
Fire Control	optical
Auxillary weapon	.303 Vickers
Engine:	
Petrol powered, liquid cooled, Ford V8 producing 85 hp. Location, rear.	
Transmission:	
Manual with 4 forward and 1 reverse gear attached to a 2-speed transfer case.	
Suspension System:	
Leaf spring, wheels steerable, front pair. No of wheels – 4	
General Data:	
Electrical – 6-volt system	

Radio-wireless set No. 19, no intercom.

MARK IVF

The Mk IVF was developed in the latter half of 1943 with the placement of an order from the British War Office for an additional 1 180 MK IVs. Owing to a difficulty in obtaining the Marmon-Herrington conversion kits it was decided to switch to the chassis of the Canadian-built Ford F60L 3 ton truck. With the Mark IVF the engine was mounted with the clutch and gearbox facing the front of the vehicle. The Mark IVF was essentially a front-wheel-drive vehicle, with the drive normally transmitted through the front axle only, but with the driver able to engage the rear wheels as well for four wheel drive. Initial armament for all Mark IVFs included the 2-pounder (40 mm) quick-fire cannon and two .303 calibre Browning light machine guns.

SPECIFICATIONS

Used by Commonwealth forces during World War II, Cyprus, Greece, Guatemala, Israel, Jordan, Lebanon, Rhodesia, South Africa and Syria post war. Most vehicles used after WWII were the IVF version.

Crew:	3
Dimensions:	
Length	5 525 mm
Width	2 134 mm
Height	2 286 mm
Wheel base	2 896 mm
Ground clearance	279 mm
Mass:	
Empty	5 784 kg
Loaded	6 756 kg
Performance:	
Top speed	84 km/h
Range	579 km
Protection Levels;	
Armour-6 to 12 mm, 4 mm under driver's compartment.	
Armament	40 mm (2-pounder gun)
Model	Witwatersrand GM QF
Elevation	Manual -5 to +20°
Traverse control	manual 360° in 22 seconds fire optical
Auxillary weapon	.30 calibre Browning
LMG	
Engine:	
Liquid cooled, Ford Mercury V8 producing 95 hp. Cooling – liquid.	
Transmission:	
Manual with 4 forward and 1 reverse gear with 2-speed transmission.	

Suspension System:

Leaf spring, wheels steerable – front pair. Tyre size – 10.50x20 run flat.

MARK V 8x8

Following a request from the UK, the South African Director General of War Supplies took on the task of developing an 8-wheel heavy armoured car for use in North Africa. With design work beginning in 1941, the running prototype (missing body) was able to be tested in March 1942. Only two of the four axles were powered (the second and third axle), with the first and fourth axle being for steering and to help distribute the load. The vehicle seems actually to have had a fairly good performance on a hard surface, but wanted to dig-in on soft soil. Even though attention was turned to the more promising Mk VI, work continued and the vehicle was re-designed with both engines now at the rear of the vehicle and a 2-pounder gun in the fully rotating turret. Although well-armoured it was heavy at 16 tons and being far too large with a marginal performance, the project was finally dropped. Only one prototype was ever built.

SPECIFICATIONS

Crew:	3

Dimensions:

Length	5 690 mm
Width	2438 mm
Height	3 000 mm
Wheel base	41 20 mm

Mass:

Loaded	16 260 kg

Protection Levels:

Armour – 40 to 60 mm
Armament – 2-pounder 40 mm
Elevation and traverse – manual

Fire control-optical
Auxillary weapon – .303 LMG

Engine:

Albion 6-cylinder inline water-cooled gasoline engines producing 150 hp (111 kW) each. Location – rear.

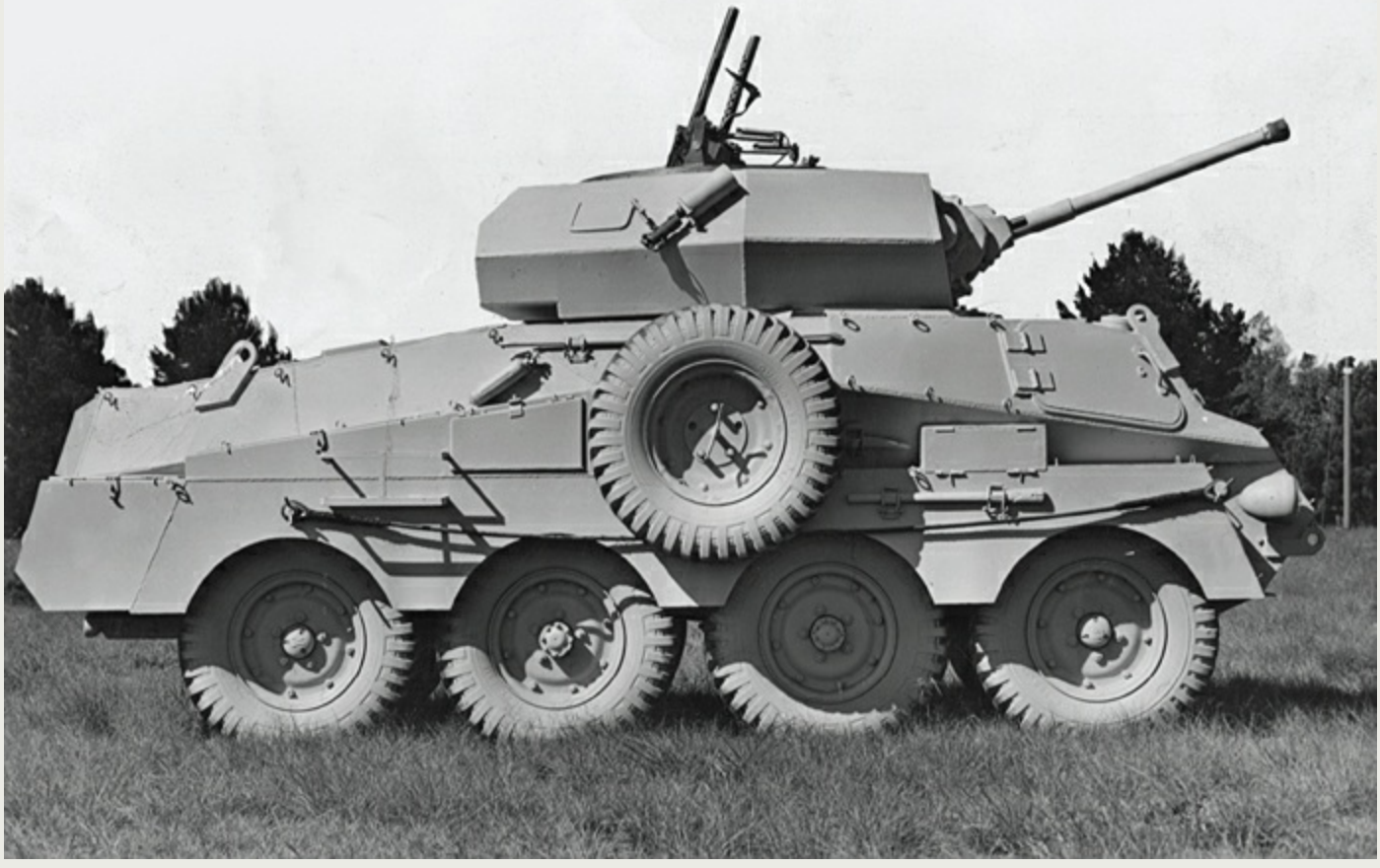
Transmission:

Manual with 4 forward and 1 reverse gear.

Suspension System:

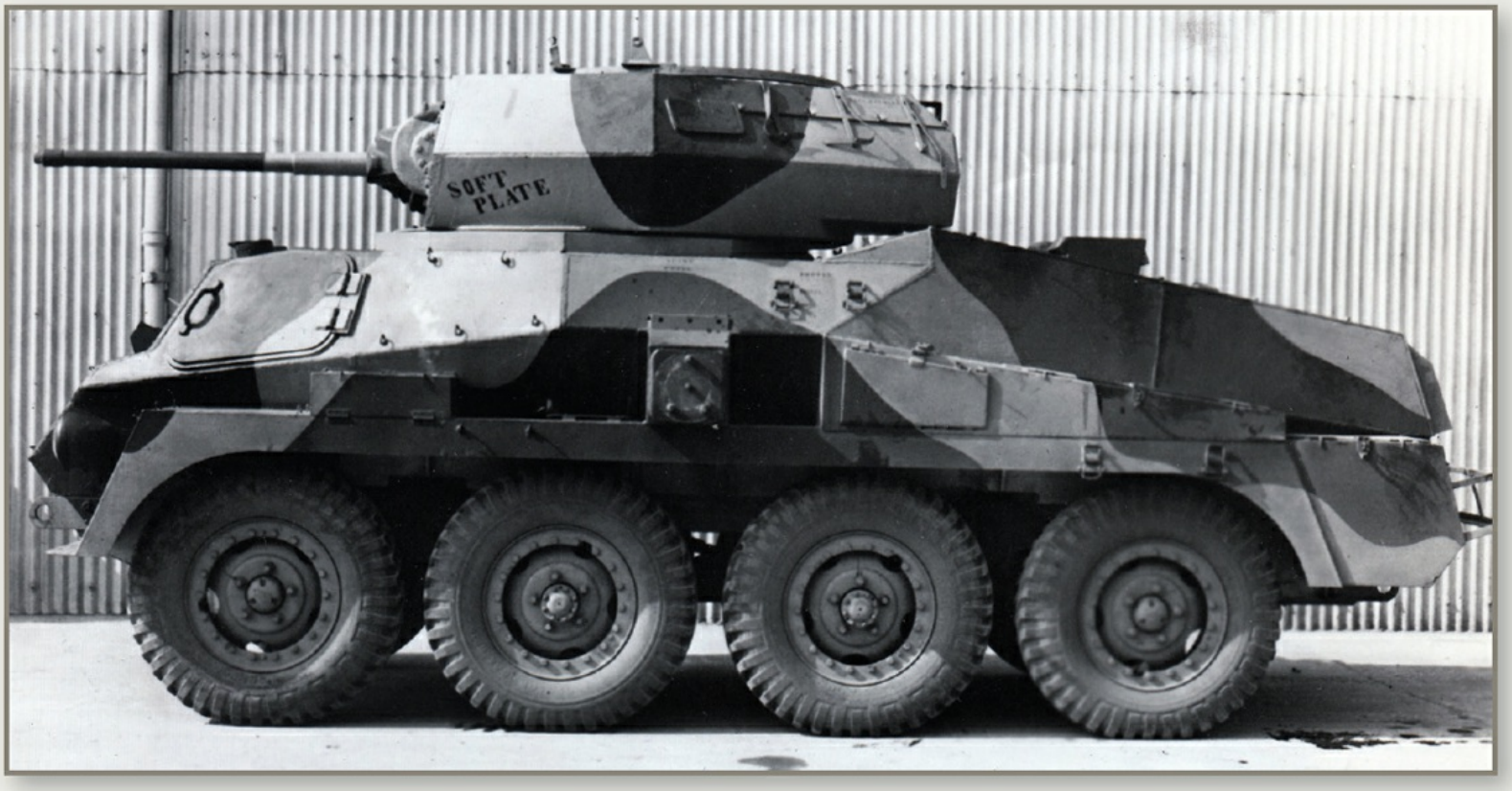
Leaf spring, wheels steerable – front and rear pair.

No of wheels -8



MARK VI 8x8

The Mark VI was another eight-wheeled vehicle, but of much lighter design. There were five prototypes completed. By 1943 work on the MkVI had progressed to a second prototype, but the pressing need for armoured cars had diminished. The British order for 250 cars was cancelled and development continued at a slow pace. One prototype was sent to the UK for testing, and can be found at the Bovington Tank Museum. Another prototype was retained in South Africa and can be found at the South African National Museum of Military History in Johannesburg.



SPECIFICATIONS

Crew:	3
Dimensions:	
Length	5 690 mm
Width	2 640 mm
Height – to top of turret	3 168 mm
Wheel base	3 240 mm
Ground clearance	304 mm
Mass:	
Loaded	11 185 kg
Performance:	
Top speed	65 km/h

Range of	400 km

Protection Levels:

Armour	10-40 mm
Armament:main-calibre, 2-pounder (40mm) or 6-pounder (57mm)	
Elevation and traverse	manual
Fire control	optical
Auxillary weapon	.303 LMG

Engine:

Ford V8s – each producing 95 hp
(70 kW) @ 3 000 rpm
Location – rear
Cooling – liquid

Transmission:

Manual with 4 forward and 1 reverse gear.

Suspension System:

Leaf spring, wheels steerable – front and rear pair.

Number of wheels – 8

MARK VII

An improved version of the Mk IIIA, the project was stopped after prototypes as it was only armed with a Vickers machine gun.

MARK VIII

Similar to the Mk III but with a 2-pounder gun in a bigger turret. The project was stopped in 1943 as requirements had already moved on to larger weapons such as the 6-pounder gun.

The South African Reconnaissance Cars – a manufacturing success

In total, 5 777 South African reconnaissance cars were built. Of those about 4 500 were

used by South African units, while others were employed bythe British, Indian, New Zealand, Greek, Polish, Dutch and Belgian forces. After World War II, a few were given to the Transjordan and saw combat with the Arab Legion in the 1948 Arab-Israeli War. The Mk IVF saw combat as late as July to August 1974, during the Turkish invasion of Cyprus, when it was used by the Cypriot National Guard. The Greek Army used the South African reconnaissance cars in the islands of the Aegean well into the 1990s, in mechanised infantry battalions of special composition, alongside Jeeps, M113s and the Greek-built Leonidas APC which was based on the Steyer Daimler Puch model 4K7FA. Remarkably, they were finally phased out of service with the introduction of the French Panhard Véhicule Blindé Léger (light armoured vehicle), six decades after their introduction.

While these were not mine-protected vehicles they have been included in this book. For a country with limited vehicle production capabilities and experience in the 1940s, the South African reconnaissance car was an outstanding achievement for the country. This was a beginning of a long heritage in years to come of world class locally designed and manufactured armoured fighting and personnel-carrying mine-protected vehicles.

The Mk III South African reconnaissance cars were extensively used during the North African Campaign. This 4x4 armoured vehicle with increased armour plating to counter the German armour and other mechanical improvements to cope with desert conditions proved most successful. Throughout the campaign the South African soldiers continued to upgrade their main armament with captured weapons; the German 20 mm gun being a favourite. Despite its antiquated appearance, this South African armoured vehicle remained the mainstay of the British armoured car regiments in the Western Desert until 1942. In the photograph below a Mk III drives past Sikh troops as part of an armoured vehicle convoy on its way to occupy Giovanni Berta in North Africa.

R 29190

Chapter

1970s, PIONEERING MINE-PROTECTED VEHICLES AND TECHNOLOGY

3

The 1970s saw guerrillas in Rhodesia and later in South West Africa use landmines to disrupt normal life by causing people to be too scared to drive anywhere, which was a real hardship in rural areas where everything was far from home. The mines also presented a threat to military movements and to reaction forces, and some were laid specifically with that in mind.

The response was to develop vehicles that would protect their passengers in the event of detonating a mine, at first using various improvised techniques, such as placing sandbags or conveyor belting under the seats to absorb any fragments or debris. That protection was, however, inadequate and did not address the problems of impulse and shock. The next step was a V-shaped hull of armour steel that would deflect the blast and keep out fragments and debris.

While the first of the vehicles built to this concept proved effective, they were very ungainly and almost comical to look at; shades of the Marmon-Herrington armoured cars. The concept did however prove itself, and more sophisticated designs followed, keeping a step ahead of the mine-layers.

TELEFOINHOKKIE

A pioneering design was the Telefoonhokkie which was developed from the V-shaped hull technology of the Chemical Defence Unit (CDU). The design of the initial V-shaped capsule was refined after a presentation by the CDU to the South African Police in 1972. A V-shaped capsule accommodating only a driver, was mounted onto a Ford F250 4x4 chassis. Only one vehicle, which was primarily used for road-sweeping tasks, was manufactured. According to a SAP report dated 12 September 1972 by the District Commandant, SAP in Katima Mulilo, no technical problems were experienced with the vehicle.

Telefoonhokkie is the Afrikaans word for telephone booth.

Telefoonhokkie (left) and the Kameel (right), both early pioneering landmine designs mounted on a Ford F250 chassis.

KAMEEL

The Kameel was developed in 1972, using the same Ford F250 chassis arrangement as the Telefoonhokkie. Provision, however, was made for the driver and four passengers seated in a capsule with a 60° enclosed wedge angle, resulting in a very cramped interior.

Four vehicles were manufactured and used by the SAP for reconnaissance and transport duties in the mine infested areas of the Caprivi Strip. Although a number of mechanical problems were experienced, the SAP recommended that all patrols should be transported in the so-called ‘anti-mine vehicles’.

Kameel is the Afrikaans word for Camel.

HYENA

In a letter dated 1 November 1972, the SAP requested the President of the CSIR to construct six *skokvaste patrolliewaens*, Afrikaans for shock-proof patrol vehicles, again using Ford F250 chassis components and a wedge angle of 60°.

The outcome was a vehicle manufactured by Sandock-Austral named the Hyena which was a vast improvement on the Kameel. Provision was made for a driver and four passengers with canvas screens fitted to the sides to disguise the V-shape of the hull. The passengers and driver entered through a rear access door.

The first six Hyenas off the production line were sent to the Caprivi Strip in early 1973. One of the first landmine incidents that involved a South African civilian occurred on the 16 November 1973. A minister of the Dutch Reformed Church, Dominee Albertyn, was travelling with a police driver in a Hyena to visit his congregation when the front right wheel of the Hyena detonated a SWAPO-planted homemade landmine consisting of 22 kg of explosives.

The mine consisted of a switch coupled to 7 kg TNT, which in turn was wire-connected to another 14 kg TNT charge. Both the TNT charges were buried in the middle of the road, whilst the switch was situated in the track to be activated by a passing vehicle.

The vehicle was totally destroyed while the driver suffered a minor injury from a segment of shrapnel flying through the gear-shift hole and Dominee Albertyn suffered a damaged eardrum.

The force of the blast blew the engine and front axle unit 120 metres across the international boundary line into Zambia. By all accounts both occupants would have been killed without the protection afforded by this vehicle.

In Rhodesia, many of the Hyenas fell victim to landmines, of which only two occupants were killed. If there was one problem the Hyena faced, it was speed. Many Hyena casualties were recorded as a result of excessive speed and failure to make use of the seat belts. The Rhodesian Army became aware that the Hyena's relatively high speed was causing injuries and modified the engines by installing governors, giving the Hyena's increased power at low speed but less at high speed.

The cost of a Hyena vehicle in June 1974 was R11 355.

The wreckage of the first Hyena to be involved in a landmine incident in SWA.

Quantity manufactured:	
SAP	37
SA Army	23
Rhodesia	146
Bantu Administration	2
SWA Administration	25

SPECIFICATIONS

Crew:	1 +4
Dimensions:	
Length	5 273 mm
Width	2017 mm
Height	3 050 mm
Wheel base	3 327 mm
Ground clearance	221 mm
Mass:	
GVM with no load	3 440 kg

GVM with load	3 940 kg
Performance:	
Top speed	127 km/h
Fuel tank capacity	80 litres
Range	560 km
Engine:	
Ford 6-cylinder in-line water cooled	
Transmission:	
Standard NP 435 heavy duty 4-speed	
Transfer box:	
Type – Dana 24 2-speed constant mesh	
Electrical System: 12-volt	

Geoff Blyth, serving with the British South Africa Police (BSAP), Special Branch was travelling along a dirt road in 1978, when the Hyena mine-protected vehicle in which he was travelling detonated a landmine. Geoff takes up the story…

I survived the ride

Allan Branfield and I were doing a call-up stint with Special Branch, and were to be based at Chiturispasi in the Beitbridge area.

From Beitbridge we drove out on the main road to Salisbury, and after 30 minutes turned off right on the dirt road to Chituripasi and Chikwarakwara. We had no support vehicle, and there was only Allan, myself and my faithful bull terrier companion, Jock. If I remember rightly it was sometime in July 1978, as the bush was dry and dusty and open.

Allan was driving, and I was sitting behind him on the left side (so I could chat to him from just behind) on a solid steel bench seat with safety belts. Jock was sitting on the bench seat opposite me. We were of course both carrying our issue FN weapons. Understanding that there was a good chance of an ambush or hitting a landmine, we were both alert and prepared! Included in the vehicle we had about 6 cases of beer, 4 cases of cokes, 5 trays of eggs, and fresh veg and meat, packed in boxes, for the Chituripasi base camp.

Chatting away we were, and had been driving for about 20 minutes at a reasonable speed along the dirt road… about 50 k's per hour. I was looking ahead along the road and Allan had just turned and said something to me, when I spotted a brown patch in the road about 30 metres ahead. It was in the right hand track, and was noticeable as it was a different colour soil to that of the sandy beige of the road. It only took a few seconds to register in my mind that it could be a landmine, and I had just shouted a warning to Allan as he turned back to watch the road. Too late, as he never had time to swerve, and BOOMM….!!!!! A huge bang, an orange flash, and black and brown dust momentarily obscured our vision as we sort of flew for a few seconds and then with a thud, hit the ground, and skidded forward until the vehicle came to a stop. Shaken and with ringing ears, we sat stunned for a second or two before unstrapping ourselves and leaping up with our weapons and pouring a rapid "prophylactic fire" into the surrounding bush. Just in case the gooks were waiting to finish us off with a rocket and small-arms attack.

Nothing further happened, so we tooka quick look inside and outside the vehicle, which was now minus the front right wheel. Smoke and dust was still settling, and at the back of the vehicle, apart from a few cases of drinks that had been knocked askew, and a few eggs broken, there was no damage, and everything was still intact. Jock was looking a bit dazed, but wagging his tail and trying to get out of the vehicle after we had opened fire. Assuming that there was something to chase, as was normally the case when I opened fire on a kudu or impala for the pot. He must have thought it was something very big with all the shots fired.

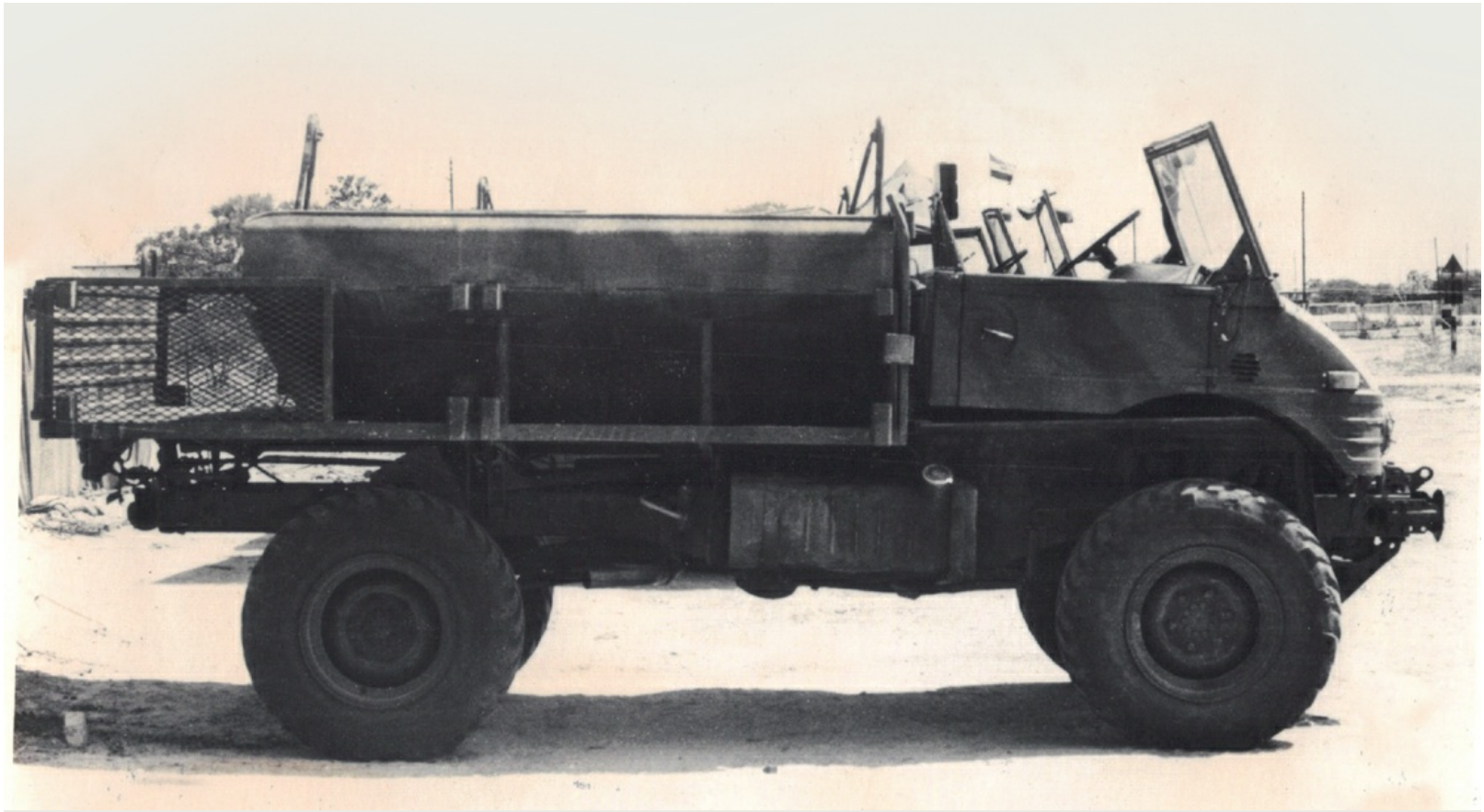
Anyway, we de-bussed, none the worse off for the explosion apart from ringing ears, and did a quick 360° check-out, being very careful to check for AP mines. I let Jock out and of course he immediately shot off to have a 'sniff' around.

About 10 minutes after the blast and making the radio call to Beitbridge on our A63 hand-held radio, much to our relief, strolling down the road came an army patrol. Which turned out to be that of a section of Selous Scouts who were operating in the area, and had heard the bang.

I must say here that if it were not for the design and sturdy build of the mine-proof, anti-ambush Hyena, we would not have been so lucky to come out unscathed.

Judging by the depth of crater left behind from the blast, and the bits and pieces of the front wheel that we found scattered around up to 50 and 80 metres away, it was assumed that it must have been a Russian TMH type mine, eithera 46 or 57? TMH standing for Tank Mine Heavy.

As a result of this incident, and subsequently the three other landmine blasts that I went through, I eventually became a member of the “TMH Rough Riders Club”a club set up for any member of the Rhodesian Army, Special Force or otherwise, who survived a landmine blast.



While the SAP and SA Army had been using the Hyena mine-protected vehicle for sometime and proved to be a very effective troop carrier on good roads, its cross-country capability was severely limited owing to instability. With the deteriorating political situation in Angola in 1974, it was clear that the SADF would be sending its troops to fight the communist-backed rebels that had over-thrown the colonial Portuguese government-This being the case they urgently required vehicles with proven off-road ability that offered some protection against landmines. The result was the Bosvark, based on a Unimog 416-162 chassis, hastily designed for the SA Army by the Defence Research Unit of the CSIR as a short-term emergency measure. 54 Unimogs were converted to Bosvarks by 61 Base Workshops in Pretoria. They offered limited landmine protection but compensated with high off-road mobility.

BOSVARK

The blast protection at the rear comprised a relatively small V-shaped tub with seating for ten soldiers sitting back to back on a central bench. Additional measures to improve mine

protection included the placement of filled sandbags and conveyor belts on the floor, together with approximately 70 litres of water inside the wheels. This practice was later discontinued owing to reliability problems with the extra weight on the wheel bearings and steering components.

Shortly after delivery to the army, the Bosvarks were deployed into Angola on the 14 October 1975 for Operation Savannah, forming part of Task Force Zulu, an attacking column that headed north towards Luanda. The South Africans' success was outstanding and the MPLA, with their Cuban backers and vastly superior equipment, crumpled before the onslaught. In 33 days Task Force Zulu's advance covered an incredible 3 159 kilometres, during which they fought and won numerous engagements, capturing many important towns.

Although the South Africans defeated the MPLA and Cubans in combat they soon became uncomfortably aware that most of their ground vehicles were outclassed by those of their opponents.

With the UN-led international arms embargo in full force against South Africa, it didn't take long before the country was developing its own range of world-class indigenous military equipment, including innovatively designed mine-protected vehicles.

The Bosvarks were used by the SA Army in SWA until the introduction of the Hippo in late 1977, a purpose built mine-protected vehicle, that had been in service with the SAP since 1974.

WOLF

Anticipating the need for a larger mine-protected vehicle than the Hyena, the Defence Research Unit had developed a prototype called the Wolf.

It was similar to the Hyena, but much larger and mounted on a Unimog chassis, that being the main infantry vehicle in use by the motorised infantry of the SA Army.

The Wolf had a few design challenges. When the mild-steel mine-protected body was mounted onto the Unimog chassis, which by design has considerable chassis twist, it caused the Wolf to sometimes change gears by itself when travelling over rough terrain.

Entrance was through a large rear door.

Only three prototype Wolfs were produced and never went into production. These three Wolfs were given to 25 Engineering Squadron operating in Ovamboland.

The Zebra was a mine-protected cargo truck developed in 1973 on the chassis of a Bedford, the standard trucks of the SAP. The main modification was the armoured and mine-protected cab.

ZEBRA

The SA Army ordered 24, the SAP 50, while the SWA Administration ordered five and two for the SWA Post Office. The SAP had three Zebra recovery vehicles as shown above. A few where used in Rhodesia with one recorded as detonating a landmine. There were two people in the vehicle, both of whom survived without injury.

SPECIFICATIONS

Crew:	1 + 1
Dimensions:	
Length	6 537 mm
Width	2 460 mm
Height	3 000 mm
Wheel base	3 692 mm
Ground clearance	320 mm
Mass:	
GVM with load	9485 kg
GVM with no load	5 786 kg
Performance:	
Top speed	80 km/h
Fuel tank capacity	200 litres

Range	680 km

Engine:

Bedford diesel 6-cylinder in line water cooled.

Transfer box:

4-Speed ZF with synchromesh on 2, 3 and 4.

Transmission:

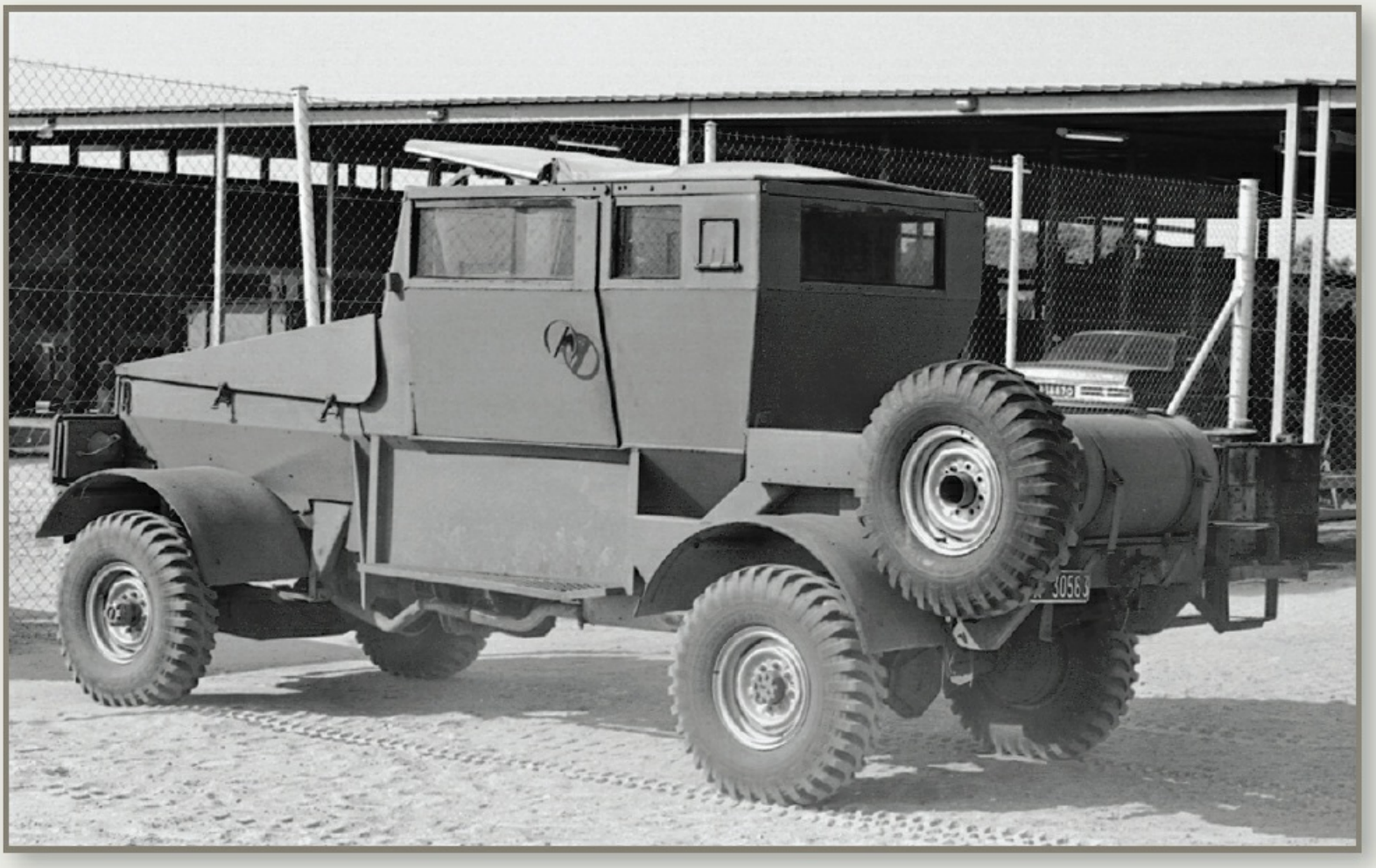
Bedford type with high and low range.

The Rooibok was built for the Police, using the chassis and driveline of the Ford F250, but only a small number were built as they were too heavy and the wheelbase was too long, which resulted in a large turning circle. The fuel tank was also unprotected and mounted externally. These vehicles were used by detectives and forensic teams. A few, believed to be three, somehow wound up being used by the Army, one by 53 Battalion at Ondangwa.

ROOIBOK

It had a five-seat armoured and mine-protected cabin and an unprotected engine and load bed. Access was through two doors, with the front passenger's seat welded into the door, which essentially had to be closed from outside – leading to some not so funny moments for the passenger if it was not properly latched. It was an exceptionally uncomfortable vehicle.

The Rooibok did, however, save lives in several mine incidents in Sector 10. Two officials of the SWA Water Affairs Department survived intense fire when some 15 guerrillas attacked them while they were working on the water pipeline between Ruacana and Oshakati. They drove off under fire, with all four tyres quickly flattened by bullets, but were stopped when one hit the distributer cap. They got out and fired at the guerrillas, who fled.



The SAP were looking for a larger landmine-protected vehicle capable of carrying more occupants than the Hyena. Ideally they wanted this vehicle to be based on a Bedford chassis, as the SAP already had many Bedford vehicles in service.

This Hippo Mk II prototype, developed by Armscor, used a half chassis and half monocoque. The chassis was cut short just before the armoured cab.

HIPPO

So began the life of a new generation of landmine-protected vehicles called the Hippo, which was to become the first landmine-protected vehicle to be produced on such a large scale with 677 eventually being manufactured.

The SAP placed an initial order in July 1974 for 150 Hippos, which had been developed by CSIR's DRU.

The Hippo Mk I-R series (as shown below) was manufactured using mild steel and RB390 armour steel, but on the next series of vehicles known as the Hippo Mk I-M, ROQ TUFF steel was used instead of mildsteel.

Both the series made provision for 12 occupants, namely a driver, co-driver and ten other personnel.

The armoured body of the hippo was V-shaped and access to the vehicle was via a rear door. The seating was inward facing with staggered seating providing outward vision across a very narrow troop compartment through armoured glass windows. There were firing ports along both sides of the Hippo.

Shortly after entering operational service with the SAP in Rhodesia the front wheel of a Hippo detonated a landmine on 28 December 1974. No one was injured in the blast.

In total the Hippo vehicles recorded 18 landmine incidents in Rhodesia, during which one person was killed and another six injured. In SWA this information was regarded as classified for the Hippos and never released.

The Hippo could reach a speed of 83 km/h on an open road, though this was inadvisable as it was heavy and not stable at such speeds.

Based on operational experience gained by the earlier Hippo series and also in part owing to cracks found in the chassis of the Hippo vehicles, Armscor in 1978 developed the Mk II series. This had an increased range of 770 km, was faster at 90 km/h and included a 80 litre water tank. Only two prototypes were built; one made use of the newer Bedford chassis and the second had a monocoque hull. This would influence the future design of all SA manufactured landmine-protected vehicles. Although the SA Army showed no interest in this monocoque vehicle, the design was later refined into what would become the very successful Casspir.

While the Hippo had served its purpose for the SAArmy it was heavy and lacked true off-road capabilities. A new prototype mine-protected vehicle had been designed in April 1976 although it would be another two years before the Buffel would eventually replace the Hippo as the SA Army's premier troop-carrying mine-protected vehicle.

When the civil riots broke out in 1976, the Police pressed the Hippo into use as a riot control vehicle mainly because they had no specialised vehicles for that role. Later the Casspir was similarly employed until finally they acquired the RG12, a South African-designed multipurpose public-order vehicle.

Quantity manufactured:	
Mk I-R series:	
SAP	150
SWA Administration	5
SA Army	120
Mk I-M series:	
SA Army	402

SPECIFICATIONS

Crew:	2 + 10
Dimensions:	
Length	6 537 mm
Width	2 460 mm
Height	3 300 mm
Wheel base	3 692 mm
Ground clearance	320 mm
Performance:	
Top speed	83 km/h
Fuel tank capacity	240 litres

Range	600 km

Engine:

Bedford petrol 6-cylinder in line water-cooled.

Transfer box:

4-Speed ZF with synchromesh on 2, 3 and 4.

Transmission:

Bedford high and low range.

The Buffel was the first truly effective landmine-protected armoured personnel carrier to enter service anywhere. The South African Army began deploying it in the operational area from 1978. It represented a vast improvement on all earlier landmine-protected military vehicles and, quite remarkably, would remain in service with the SADF (SANDF) for over 17 years. Although rather ungainly looking and not very comfortable, the Buffel soon became a much-loved vehicle on the border owing to the very good protection it provided its occupants against the ever-lurking danger of landmines.

BUFFEL

Fligh, to raise the troop compartment well clear of a mine to attenuate the blast, and somewhat top-heavy as a result, the Buffel swayed from side to side when driving cross-country, earning it the nick name of *kots koets*, Afrikaans for vomit wagon. The extreme body-lean in a sharp turn could also be frightening until one became used to it. With its excellent off-road capabilities it was also given another nick name, the *grens donkie*, Afrikaans for border donkey.

The Buffel formula was very simple, an armoured ‘bath tub’ with a V-shaped, blast-deflecting bottom, mounted on a Unimog Model 416/162 series 4x4 chassis with superb off-road mobility. The ten-man troop compartment had centrally mounted, outward-facing seats, enabling the section to fight from behind the side armour plates until de-bussing was practical. Each seat had a full four-point harness to prevent injury should the Buffel roll over and to prevent passengers from being flung from the vehicle in the event of a mine detonation. The seats themselves were specially designed to absorb as much of the shock as possible in the event of a mine detonation, reducing the risk of compression fractures of the spine. The hard seat cushions required to achieve that, were not very comfortable but performed their task admirably. A longitudinal roll bar protected the troops should the vehicle roll over entirely – assuming they were strapped in. There was a bracket on the hull side for each soldier to clip in his rifle, to prevent that from being flung about in a mine blast, causing injury and possibly being flung out and leaving the soldier unarmed.

R 9236

The armoured driver's cab, on the left with the engine compartment on the right, was also designed to ensure that no transmission or engine components intruded into the driver's area in a landmine blast.

The troop compartment had hinged sides that dropped down for troops to quickly debus from the Buffel. In combat the sides were seldom dropped, as it not only consumed precious time but they had a tendency to swing back and cause injury. Typically the troops would debus by jumping over the sides. This was a drill much practised as it required some skill to do so with full combat gear given the height of the troop compartment from the ground.

Contained in the base of the V, below the floor of the troop compartment, were two plastic tanks; a 200 litre diesel tank and a 100 litre potable water tank. The water tank provided drinking water to the occupants by means of a tap at the rear of the Buffel. The Buffel had a large fully enclosed stowage bin mounted externally at the rear of the hull.

The first Buffels were known as Mark I, and had the original Mercedes Benz engine. The Mark IA was fitted with drum brakes, while the Mark I B had disc brakes. The Mk II A, referred to as the Moffel, see page 92, was essentially a rebuild of the original Mk I, fitted with a new fully enclosed rear troop compartment with a large access door at the rear and large bulletproof windows at the front, sides and rear. It was intended for urban security operations, the windows giving the necessary visibility from inside and the roof preventing petrol bombs being thrown into the vehicle.

It is estimated that once production came to an end, around 2 400 Buffels had been manufactured for the home and export markets. Interestingly, despite the UN-led international arms embargo against South Africa, Siri Lanka purchased a number of Buffels in the 1980s, known there as the Buffalo, many of which are still in use. The vehicle was exported to Uganda in the early 1990s.

In the early 1990s the Buffel was gradually phased out of service with the SA Army, being replaced by the Mamba armoured personal carriers that entered service from 1995. *Buffel* is the Afrikaans word for Buffalo.

SPECIFICATIONS

Crew:	1 + 10
Dimensions:	
Length	5 100 mm
Width	2 050 mm
Height	2 955 mm
Wheel base	2 900 mm
Ground clearance	420 mm
Mass:	
GVM with load	6 143 kg
GVM with no load	5 043 kg

Performance:

Top speed	93 km/h
Fuel tank capacity	200 litres
Range	1 000 km

Engine:

Buffel MKI – OM 352 6-cylinder diesel, water cooled Mercedes Benz.

Buffel Mk I A, B and Mk II – Atlantis Diesel Engine 352 6-cylinder diesel water-cooled Mercedes Benz.

Gearbox on all Buffel Mks:

Synchronised 8 forward and 4 reverse gears.

Transmission on all Buffel Mks:

Integral with gearbox. In motion changing between 4 and 2 wheel drive (pneumatically controlled).

Power distribution – 50% front axle and 50% rear axle.

Axle type on all Buffel Mks:

Banjo type. Drive via bevel pinion on crown wheel differential gears with pneumatically lockable differentials.

Electric system: 24-volt system

The early development stages of the vehicle that was to become the Buffel was known as the Bosvarkll. Seen above, the Bosvarkll starts to take shape in 1976. After almost two years of extensive field trials in Ovamboland and blast tests, the Bosvarkll was modified and eventually went into production in early 1978 and finally entering service with the SA Army later in that year, as the Buffel.

The Buffel Mk IB mine-protected cargo carrier was first manufactured in the early 1980s. The SA Army ordered 57 as a 2.5 ton general-purpose cargo carrier. This vehicle had a single mine-protected cab for the driver and an open load bed. It weighed 6 tons, had a 2.637 ton payload and was 2.68 m high.It had a fuel capacity of 180 litres with an approximate range of 900 km. It also had a smaller drinking water tank capacity of 25 litres, but in all other respects the specifications were similar to the Buffel. This vehicle was often called the *Pìatbak* Buffel, Afrikaans for flat bed.

R1949

The Buffel MklB mine-protected ambulance was developed as a prototype in the early 1980s. The crew consisted of a driver, five patients, (four lying and one walking wounded) and two medical officers.It never went into service as the Buffel's rolling motion with off-road driving would have caused discomfort to its wounded. The specifications were similar to the Buffel.

A
B
C
D
E
F
G
H
I
J
K
L
M

KEY DESIGN FEATURES OF THE BUFFEL

A. **Driver's cab** top was open and in the earlier Buffels this is where the driver entered and left as the vehicle had no cab door, until later modifications included one.

A high density polyethelene roof cover was later added to the driver's cab.

B. **A strong longitudinal roll bar** above the seats protected the occupants in the event the vehicle should roll.

C. **Rear troop compartment** was open and seated ten soldiers, five down either side back to back facing outwards. Each seat was provided with a seat belt harness with specially designed seats to absorb as much of the shock as possible in the event of a landmine detonation.

D. Large fully enclosed **stowage equipment box** mounted externally at the rear of the hull.

E. **A welded steel armour V-shaped hull** deflected the pressure wave, reducing the amount of energy transferred from the explosion to the vehicle and prevented shrapnel from penetrating the troop comparment, providing excellent protection for its occupants.

F. **Two plastic tanks** in the V beneath the floor of the troop compartment contained, a 200 litre diesel tank and a 100 litre potable water tank.

G. **External drinking water tap** for easy access.

H. **Suspension system,** single coil springs in front and double coil springs at rear.

I. **Good ground clearance** gave the vehicle excellent off-road capability and reduced the effectiveness of a landmine blast as a result of the height of the V-shaped hull from the point of detonation.

J. **The chassis** was a Mercedes 4x4 Unimog 416/162 series.

K. **Entry and exit** to the troop compartment was solely by means of climbing over the sides of the hull which was provided with fixed ladder-like steps.

L. **Driver's cab** was a separate all-welded steel V shaped protected cab situated on the left with engine compartment on the right, above which was the spare tyre.

M. **The hull sides were hinged** at the lower part, allowing the top portion to fold outwards and down.

Michael Hill, a national serviceman in 1977, survived a landmine blast while travelling in a Buffel in the operational area of South West Africa, close to the Angolan border. He takes up the story…

I survived the ride

Our unit, B Company from the State President's Guard, had been sent to relieve 32 Battalion at a base camp called Elundu near Eenhana in July 1977. We were there for five months. Here the legendary *Oom Williese Pad* was well known for its landmine activity.

We patrolled a large area east of Elundu by foot where we were taken out and dropped off some 30 kilometres from our base camp. Our main mode of transport to our dropoff point was by Buffel.

On each occasion when we were taken out on patrol by Buffel we had to bundu bash our way clearing a fresh track to our destination. Once dropped off, the vehicles would return with the guys we had relieved and back-track along the same fresh newly made tracks. It was often on this return trip back to camp when the mines were laid in the soft sand. Whenever we detonated a landmine, this always resulted with one section staying with the crippled vehicle while the other two sections picked up the terrorists tracks with a hot pursuit follow-up.

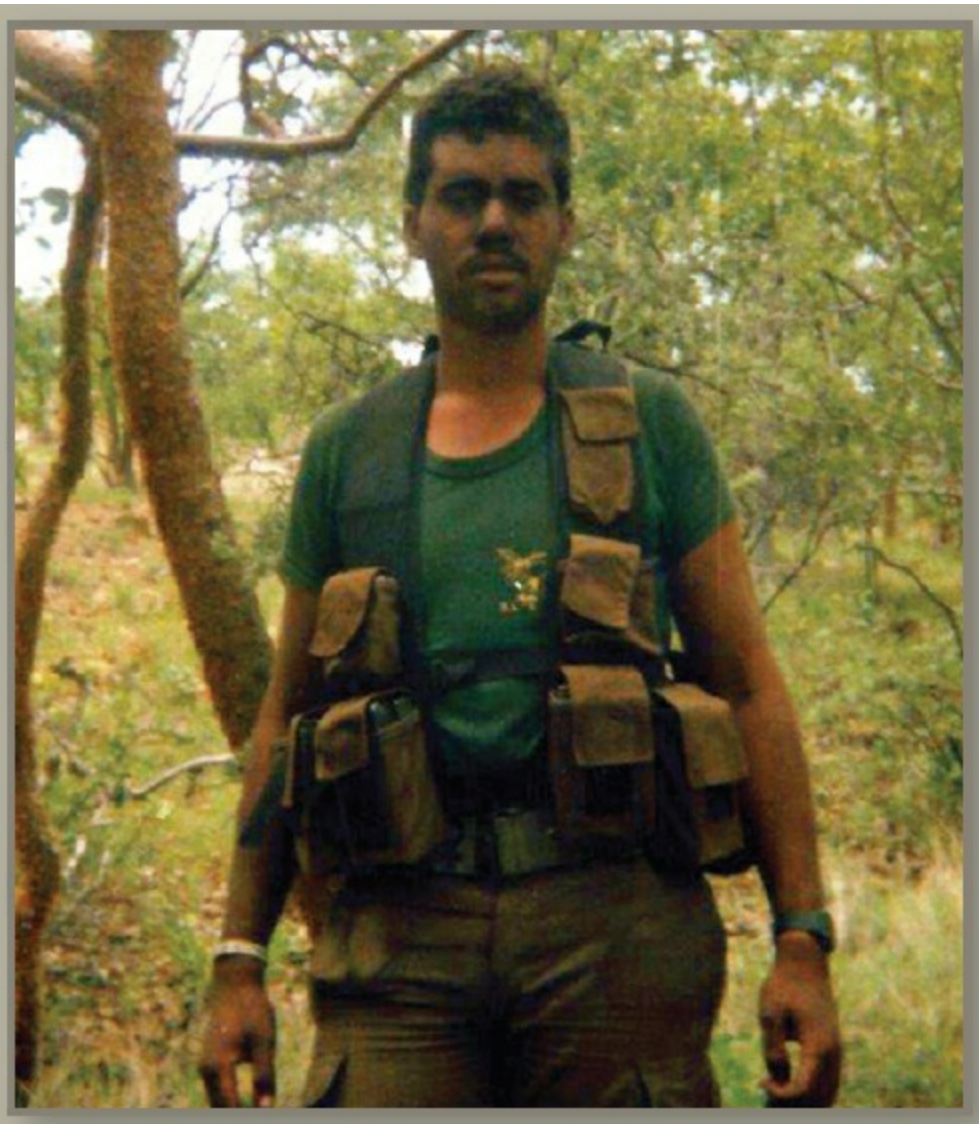
We would track till nightfall and then call in the Parabats (who were inserted by Puma helicopter) with dogs to assist us into the night. The dogs were quicker in failing light and could smell and alert us to any pending danger or ambush. Once we reached the cutline, permission had to be given by higher command either to enter Angola or abort the hot pursuit. As the frequency of the rain increased so too did the terrorist activity.

Christmas Eve 1977, our last patrol was one that we would always remember. We hit a landmine mid-afternoon while returning to camp after a three-week patrol. Fortunately we were strapped in and no one was injured. Once we had recovered from the initial shock of the incident, we immediately started our follow-up hot pursuit around three in the afternoon

on the tracks of three terrorists. By six that evening we were right on their heels and knew we were closing in on them as we could still see their urine pooled in the sand where they had taken a “leak”. It was clear they knew the terrain very well as their route back to Angola took them past clupper trees where the segmented fruit from the trees would sustain them.

We called in the Parabats with dogs, who were dropped in by the Pumas, just before nightfall. Unfortunately at about eleven that night it started to rain and our dogs lost the scent, forcing us to call off the chase. Still etched in my memory was the long trudge back to the Buffel in the rain thinking of everyone back home in South Africa celebrating Christmas. We got back to the Buffel at eight the following morning, Christmas Day. We had to wait for the recovery vehicle and the escort back to camp.

Two days later we were back in the “States” having survived five months at Elundu where I saw five Buffels and one Hippo destroyed by landmines, with everyone having amazingly survived the blasts. Credit really must be given to the protection the Buffel afforded us and the design engineers as we had no serious injuries other than bleeding ears. We left just in time as the landmines were starting to be piggy-backed and charged with explosives. I was only eighteen.



Me minutes after the area was made safe. The skin on my left cheek got a bit charred and black all over from the blast.

Theuns Steenkamp, a SWA national serviceman in 1987, survived two Buffel landmine incidents in the operational area of South West Africa. He takes up the story…

I survived the ride

I was a member of 1 SWA Engineers team, based at Alpha base, just south of Opuwo, 102 Battalion in Kaokoland.

My first incident happened on 20 February 1987 on our way to Otchinjau in Angola via Chitado. It was in the Djamba area. On our fourth day into Angola in a mountainous area at about 11:00 am, my Buffel detonated an anti tank landmine. We were the third vehicle from the front in the convoy.

My sapper team was resting that day, so all of us were on the vehicle. I removed my rubber seat and sat on the left front corner of the troop bin right above the driver cab when suddenly the left front wheel detonated a landmine. CHAOS!! I was blown up into the air in the mushroom cloud. How did I experience it? First, the eye-blinding flash on the ground, the air being vacuumed out of your lungs and then the MASSIVE pressure underneath you with the INTENSE heat blowing into your face. It happened in a split second. I came down, falling through a tree, fortunately landing on both feet in a crouched position, suppressing my landing.

Afterwards, we found pieces of the timing/arming device of a TM 57 anti tank landmine in the area of the blast hole. Around my vehicle were two anti-personnel mines, the PMD 6 “doodskissies”, planted to cause more human devastation. Luckily in all the chaos of the blast, no one stepped onto these small mines, which were found, dug out and made safe afterwards.

On my way down to earth, I noticed that all my limbs were intact. After I hit the ground, I jumped up, got into the vehicle tracks and ran towards the two vehicles in front. My concern was to get away from my vehicle as quickly as possible in case

an RPG or small-arms fire could blow holes into us. I had no fire-arm with me at that stage, as it was in the Buffel.

Two troops on the bin were blown off the back. The other troops immediately disembarked from the vehicle. The driver, whose cab door was fastened in an open position with a kit strap because of the summer sun and engine heat, was blown clear out of his driver's seat. There were no casualties.

My second mine detonation was in mid-August 1987 outside Opuwo in a north-easterly direction towards the Etoto mountain range. I commanded a sapper team to escort a ComOps team with Lieutenant Willem Dreyer and two sections out to do some local community chats. We were driving in a convoy of three Buffels. The third vehicle from the front, a gain MY vehicle, detonated a PTMi-Kanti-tank landmine with its left rear wheel. The speed on the vehicle speedometer was 55 kilometres per hour. I was in the command seat at the backand could see the dashboard controls clearly.

We were all strapped into our seats. The vehicle ran for about 30 metres before coming to a standstill on the road. No brakes could be applied. Luckily the Buffel remained upright. Inside the troop bin was chaos again. Ammunition for my LMG, detonators for the PE 4 explosives and blood were scattered on the troop bin floor. The LMG was standing in an upright position in the left front corner. After the blast, the gun slammed backwards and hit the third guy on my side on his mouth and split open his lips from underneath his nose down to his chin. We had all survived another landmine blast.

The driver, in black shorts and T-shirt is running back to the Buffel to grab his helmet and rifle. This photo was taken a few minutes after the blast. The arrow shows where I was sitting.

Lt Koot Potgieter and Cpl Vicko Becker, both from 1 SWA Engineers of 102 Battalion, Kaokoland, carefully lift the two PMD 6 mines they found next to our Buffel after the blast.

The Ribbok was developed as a light mine-resistant patrol and utility vehicle. These were essentially for use in SWA. In total, some 193 were manufactured by the mid-1970s. The South African Police, who were operating in a 'counter-insurgency' role in South West Africa, ordered 86 while 106 were ordered for the private sector living in mine-infested areas of rural SWA. The remaining one manufactured being the initial prototype. A few Ribboks also found their way unofficially into service with the SA Army.

RIBBOK

The armour was adequate protection against small-arms fire and offered the driver and four passengers a good chance of survival without serious injury when detonating a landmine. The purchase price of a monocoque Ribbok in June 1980 was R19 437. As can be seen from the photographs on the right, a number of variants were available with slight modifications to the body, bin and mudguards.

Ribbok is the Afrikaans word for a roe buck, a male roe deer.

SPECIFICATIONS

Crew:	2 + 3
Dimensions:	
Length	5 273 mm
Width	2 017 mm
Height	2 650 mm
Wheel base	3 327 mm
Ground clearance	221 mm
Performance:	
Top speed	127 km/h
Fuel tank capacity	180 litres
Range	1 000 km
Mass:	
GVM with load	4250 kg
GVM with no load	2 750 kg
Engine:	
Ford 6-cylinder in line water cooled	
Transfer case:	
Standard NP 435 heavy duty 4-speed	
Transmission:	
Type Dana 24 2-speed constant mesh	

The Swerwer was developed as a light mine-resistant patrol/utility 4x4 vehicle that was used mainly in South West Africa by the SAP. The SA Army evaluated this vehicle, but no purchases were made owing to the limited interior space and the fact that the vehicle did not have the same wheel track as their other vehicles then in use in the operational area.

SWERWER

Despite that, 214 were manufactured in the late 1970s, for the SAP who were operating in a counter-insurgency role in SWA. A few Swerwers were also in service with various SWA government departments that worked in the landmine-infested areas of rural SWA.

The Swerwer was based on a Land Rover series III S running gear, which was in wide use by the SAP, simplifying serviceability with spare parts for the Swerver.

It had a monoqcue body with seating for the driver and a crew of four. Entry was through a single rear door. Large bulletproof windows provided good all-round visibility and protection for the driver and crew against small-arms fire.

They were eventually phased out in favour of larger armoured personal carriers such as the Casspir. *Swerwer* is the Afrikaans name for wanderer.

Quantity manufactured:

Petrol models:

SAP – 108

Eskom – 20

Caltex-4

SA Railway Police – 42

Dptof Transport-4

Natal Parks Board – 1

Diesel models: SAP – 33

SPECIFICATIONS

Crew:	1 +4
Dimensions:	
Length	5 500 mm
Width	1 740 mm
Height	2 260 mm
Wheel base	3 700 mm
Ground clearance	370 mm
Masses:	
GVM with load	3 340 kg
GVM with no load	2 890 kg
Performance:	
Top speed	96 km/h
Fuel tank capacity	90 litres
Range	470 km

Protection level:

Against aTM-57 landmine and small-arms.

Engine:

Land Rover R6, 6-cylinder overhead camshaft petrol engine, water cooled.

Transfer case: Synchronised 4-speed

Transmission: Two/four wheel drive

If one vehicle can lay claim to being the grandfather of all landmine-protected vehicles, it must surely be the Casspir. Since the first prototype was manufactured by TFM in April 1979, an estimated 2 800 of these legendary vehicles have been built. This quintessential mine-resistant, armour-protected, personnel carrier is considered by many as one of the inspirations and indeed forerunners of the MRAP military class vehicle that has gained popularity with most western armies.

CASSPIR

The Casspir was developed by the DRU of the CSIR at the request of the SAP based on a need for a new generation mine-protected vehicle to support their COIN units operating in mine-infested areas of northern SWA.

The chief criteria for the design was good off-road mobility, mine protection, armour protection against small-arms fire and anti-personnel mines, and ease and speed of repair by a light workshop crew in the field after detonating an anti-tank mine.

The Krokodil, Afrikaans for crocodile, was a prototype mine-protectedtroop carrier developed by the CSIR.

In 1978 the CSIR had developed a prototype Krokodil with Bedford components, seen in the photograph below left. It was monocoque in design with no chassis and the suspension components being bolted to the rigid hull. In the same year Armscor developed the monocoque Hippo Mk II R-Series shown in the photograph below right.

The vehicle derives its name Casspir from the anagram for SAP and CSIR.

After two years of field trialling the Casspir, the SAP were eventually satisfied they had a good vehicle and in March 1980 placed an order for 140 Casspirs.

The Casspirs were deployed to the operational area of SWA with the SAP COIN unit, known as Koevoet, whose considerable operational success was owed in no small measure to the mobility given to them by this extraordinary vehicle. In time to come the SA Army would adopt the Casspir for use by 101 Battalion and later 32 Battalion and 5 Reconnaissance Regiment.

This R-series Hippo, was developed by the CSIR and used a monocoque hull, this design was later refined to become the Casspir.

The degree of mine protection was quite remarkable with the Casspir being certified to protect its occupants against a triple TM-57 mine blast under any wheel or a double mine blast, 14 kg of TNT, anywhere under the hull. The key to this protection lay firstly in the sturdy V-shaped armoured hull which deflected the blast and debris from the crew compartment and, secondly, in the vehicle's stability, which generally prevented it from being overturned. The fuel tank was enclosed within the hull to protect it from blast effects, and was fitted with a blastproof cap. The engine and transmission were also entirely enclosed within the hull, and the few external components had their own armour protection. For example, the battery box and engine sump drain were entirely blastproofed.

The Casspir's excellent off-road mobility results from its well-designed but simple suspension and its rugged powertrain. The long leaf springs allowed for an extreme degree of deflection, and rapid axle rebound was countered by check straps, enhancing stability and reducing discomfort. The front of the Casspir had been toughened up so that it could be driven through heavy bush without damage. Routine maintenance was simplified by the use of modular, easily accessed components that were interchangeable.

The basic armament was concentrated on the forward arc, although the main machine gun mount could traverse to either side. Operating in fighting groups of four vehicles, the usual armament was for two Casspirs to have a 12.7 mm or 20 mm and the other two being armed with 7.62 mm guns.

The crew generally consisted often to 12 men, including the driver and commander. The troop compartment extended right to the rear of the vehicle and the troops sat facing inwards on individual seats with four-point safety harnesses.

In each side of the hull were six rectangular firing ports and three oblong bulletproof windows.

The troops gained access via two rear doors, both of which had a bulletproof vision block and firing ports underneath. The rear doors were air-powered assisted, with remote operation by the driver.

The original versions of the Casspir had an open roof, but a steel roof was fitted to vehicles used in the internal security role for protection against petrol bombs and grenades.

All versions of the Casspir armoured personnel carriers had a 200 litre drinking water tank with two spare wheels.

Koevoet would generally operate in fighting groups of four Casspirs and a Blesbok supply truck, patrolling for five to seven days and typically covering 600 to 800 km. If a patrol was expected to last longer or cover more ground, a Duiker diesel tanker was attached to the group.

59397 H

SPECIFICATIONS

CASSPIR MK 1

Crew:	2+10
Dimensions:	
Length	6 880 mm
Width	2475 mm
Height	3 140 mm
Ground clearance	365 mm
Wheel base	4 200 mm
Mass:	
GVM with no load	9 305 kg
GVM with load	10 704 kg
Payload	1 403 kg
Performance:	
Top speed	90 km/h
Range	850 km
Grade ablity	low range, 50% high range, 30%
Turning circle	curb to curb, 18 m wall to wall, 21 m

Protection levels:

Ballistic – 7.62x51 mm NATO Ball, 7.62x39 mm AK-47 Bal.

Landmine – Triple TM-57 under any wheel (equivalent to 21 kg of TNT).

- Double TM-57 anywhere under the hul (equivalent to 14 kg of TNT).

Engine:

Make – ADE 352T

6-cylinder diesel turbo-charged water cooled.

Maximum power 96 Kw @ 2 800 rpm
Maximum torque 344 Nm @ 1 600 rpm

Transmission:

Model – 1 DB G-5 speed synchromesh

Transfer Box: Type – VG 500-3W

Steering system:

Hydraulically assisted re-circulating ball.

Axles:

Front – AL 3/2-5, palloid.

Rear – HL hypoid differential lock, HL 5/IS-10.

Suspension:

Front and rear – semi-elliptic leaf spring Shockabsorbers – double acting, telescopic hydraulic, front axle articulation limited by straps.

Upgrades and Variations

Some 190 of the Mk Is were manufactured by Henred Fruehauf. In 1981 the production of the Casspir was taken over by TFM who developed the improved Mk II. Externally they

were both very similar except for the left-side escape hatch, which was ineffective and was removed.

Over the years the Casspir has been developed with different power pack options:

The Casspir was initially fitted with a Mercedes Benz OM-352A diesel developing 166 hp coupled to a Mercedes Benz MB G5 5-speed manual transmission and a Mercedes Benz VG 500-3W transfer box, the axles having been replaced by Mercedes Benz axles with ZF axles being offered as an alternative.

When the SA Army showed interest in the Casspir in 1984, Armscor insisted that the V-shaped hull be increased in thickness, 14.00xR20 tyres be fitted and a 352T engine be installed which delivered 124 kW.ZF axles with limited slip differential were also fitted. This variant became the Casspir Mk III.

In July 2004 BAE Land Systems South Africa OMC was awarded an upgrade and refurbishment contract for the 174 Casspir Mk II vehicles used by the SANDF. The upgrade and refurbishment to the enhanced Mk III standard included structural modifications for increased mobility and with more-robust ZF axles.

A Mk IV version with a Tata driveline system was developed by Mechem in 2010 which were utilised in demining contracts.

Using the same unitary hull, dimensions and driveline, TFM developed a range of support vehicles in 1982.

Mk I

The Mk I made extensive use of Mercedes Benz truck components and more specifically the engine, axles, gearbox and transfer box. Fourteen persons could be accommodated in this vehicle.

Blesbok

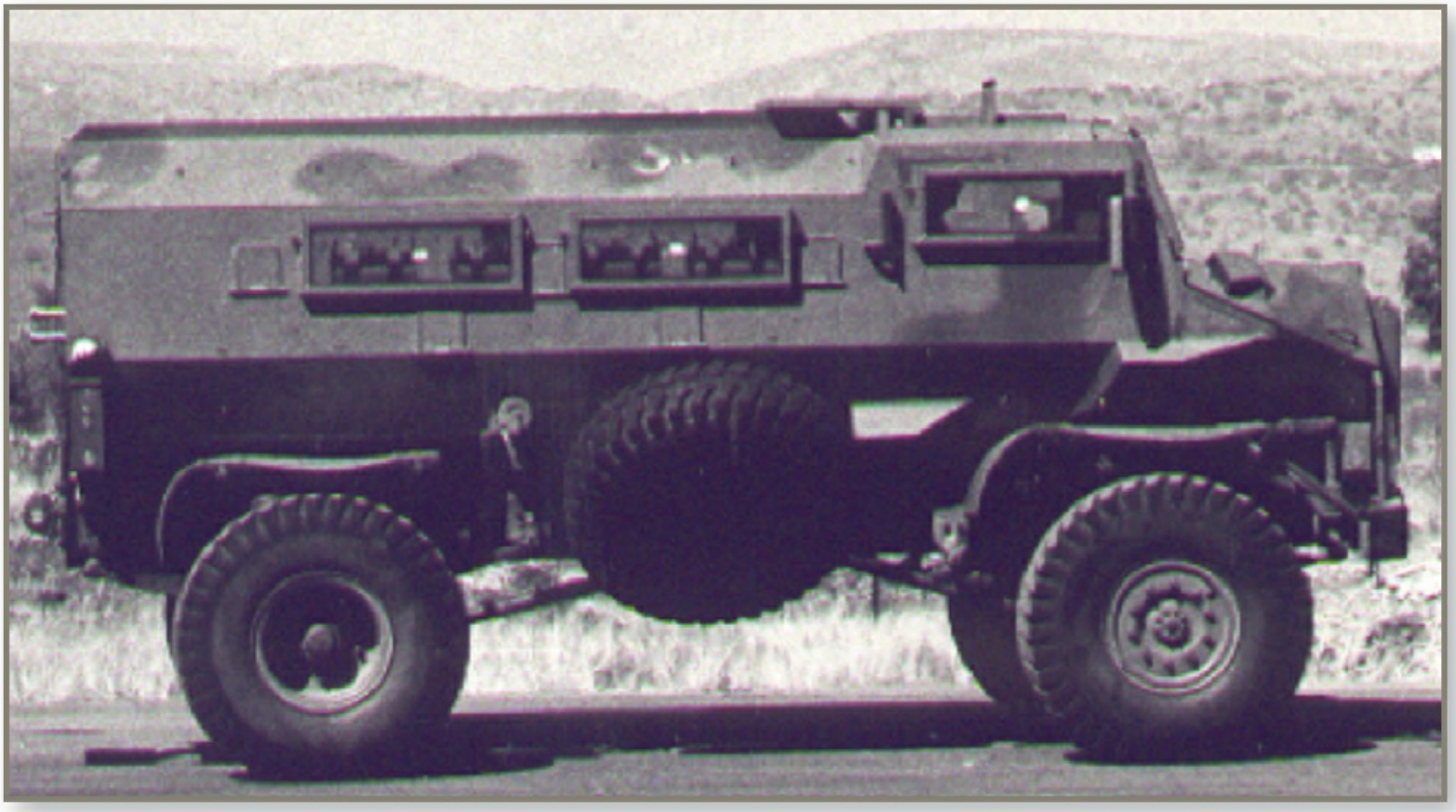
The Blesbok was a logistic vehicle derived from the Casspir and using the same powertrain. It was the standard supply vehicle of the SAP COIN units operating in SWA, with one allocated to every fighting group. It usually carried ammunition, rations, spares, fuel and camping equipment to allow the group to operate a week or two without resupply. The Blesbok had a fully armoured mine-protected two-man cab at the front and a dropside rear cargo area that was able to carry five tons. All three variants (Blesbok, Duiker and Gemsbok) had individual side doors for both the commander and widow. In total 160 were manufactured for the SAP.

Duiker

The Duiker diesel bowser was derived from the Casspir and using the same powertrain. Slightly heavier it was otherwise identical to the Blesbok except for the bowser tank in place of the load bed. It was originally fitted with a square 3 000 litre bowser tank (as shown in this photograph) and later produced with a 5 000 litre round-shaped bowser tank. The tank was fitted with a gravity feed system for dispensing fuel with an electric fuel pump as an option. As with the Blesbok provision was made for the mounting of a single light machine gun on the roof of the armoured and mine-protected cab. In total 30 were manufactured for the SAP.

Gemsbok

The Gemsbok 15 ton armoured mine-protected recovery vehicle was also derived from the Casspir. It had a larger armour and mine-protected cab than either the Blesbok or Duiker, providing seating for a crew of five passengers and fitted with recovery equipment. There was an additional side door on the left-hand side of the Gemsbok. At 6 764 m it was the shortest of the Casspir family, and was also the heaviest with a mass of 15.8 tons. There were 30 Gemsboks manufactured for use by the SAP COIN units in the operational areas.



Casspir Dumpy

A shortened version (approximately one metre shorter) of the Casspir was developed and purchased by the SA Army in 1982 in order to be evaluated against the requirements for the Buffel replacement project. The vehicle, called the Casspir Dumpy, performed well during the evaluation, but was not considered for any further development.

Casspir Mk III police variant with large side cab windows but without the metal mesh window coverings.

SA Police Riot Control Version

This version of the Casspir had larger cab windows to increase visibility for use in urban areas with metal mesh covering the windows and lights. The mesh metal grill covering the commander's and driver's windscreen could be pneumatically raised for improved visibility. A wirecutter was mounted on the roof and the front bumper was designed to be lowered from inside the vehicle to push aside barricades and other obstructions.

Plofadder

The rear compartment of the Casspir has been modified to fit the containerised Plofadder 160AT rocket-propelled mine-clearing system. This system slides into the Casspir on a retractable rail system. It is launched through the open roof.

Plofadder Mine-clearing System.

Casspir Mk III Ambulance.

Casspir Ambulance

This is an armoured mine-protected ambulance version of the standard Casspir, using the same hull and powertrain. The cabin interior has been adapted to carry two stretcher cases and three seats in the rear compartment with a driver and co-driver in the front. Ample storage is provided for medical equipment and the cabin can also be fitted with blackout curtains.

Casspir Mk III 81 mm mortar weapons platform.

Casspir Mk III 106 mm recoilless gun.

Casspir Weapons Platform

Two more variants of the Casspir Mk III have been developed for use as weapons platforms; one for the Denel Land Systems 81 mm mortar and the other for the 106 mm M40 recoilless anti-tank gun. The weapon platform versions are conversions of existing vehicles and not new-build vehicles. In the case of the 81 mm mortar version, the fully enclosed crew compartment is at the front and provided with all-round protection. The 81 mm mortar is mounted in the rear and is provided with armour protection and bulletproof windows to the sides. A total of 192 81 mm mortar bombs are carried in ready-to-use racks together with their associated fuses and propellent charges.

The 106 mm M40 series recoilless rifle weapons carrier also has the fully enclosed troop compartment at the front but the sides and rear can be quickly folded down into the horizontal position to allow the weapon to be laid onto the target. A total of 12 rounds of 106 mm high-explosive anti-tank ammunition is carried for ready use. In both cases the weapons can also be removed from the vehicle and used in the ground role if required by the tactical situation or if the vehicle becomes damaged or disabled. A roof-mounted 7.62 mm machine gun is provided for on both vehicles for immediate all-round defence.

Mechem Mine-clearing and -detection Vehicle

The Mechem-designed Vehicle Mounted Metal Detection System (VMDS) uses a modified Casspir as the systems carrier to tow a rubber mat, which consists of three basic elements. The first is the actual electronic detection, the second the signalling and record capturing and lastly the physical marking of the position of the detected item with white marking fluid on the ground. The VMDS has cleared thousands of kilometres of roads in Sudan and Eritrea for the UN. Should a landmine be detonated the occupants working in the Casspir have a very high level of protection.

Mechem Steel Wheels Mine-clearing Vehicle

The steel wheel is an excellent innovation that was designed to assist Mechem countermine teams in their humanitarian mine-clearing operations. This tool allows teams to safely clear large areas of anti-personnel minefields using steel wheels very quickly and cost effectively. The steel wheels are fitted onto the Casspir which then simply drives over and detonates anti-personnel landmines, with the operators safely within the vehicle. Should a steel wheel

be damaged during a detonation it can be quickly replaced in the field.

The Sesspir

In 1984-85 the CSIR developed a prototype Casspir with six wheels as a result of feedback from troops who lost a Casspir's front wheel on a landmine during a contact in the operational area, which resulted in them still being able to return fire but immobilised. This vehicle steered with the regular front wheels and was equipped with winch cables to hoist either side of the axle clear of the ground in the event of the loss of a wheel. The axle was intended to be sacrificed in the event of detonating a landmine. There was no larger engine as the big nose cone may suggest. The idea was shelved as there was simply not enough power in the soft sandy conditions to 'push along' the front axle. The axle also created numerous problems when crossing trenches or other obstacles as it was a non-driven axle. It was referred to as the Sesspir, ses the Afrikaans word for six. Only one prototype was built.

International Markets

Casspirs are in service in some 20 countries, with the largest user outside of South Africa being India who operate the Casspir MK IIs for their counter-insurgency operations. In September 1998, the Indian Army awarded Reumech OMC a contract to supply 90 remanufactured Casspir MK IIs and subsequently placed additional orders for MK IIs, which brought the total number of vehicles supplied to 165 units.

A number of private security companies operating in Iraq and Afghanistan utilised the Casspir during the period of conflict there.

Since 2000 a few factories in South Africa have started to remanufacture the Casspir Mk II for markets in developing countries, offering a low-budget but still a very effective mine-protected vehicle that in many ways continues to be a leader in this field, with an enviable record for saving lives in landmine incidents. One such company is N4 Trucks who have improved the armour on the Casspir which they market as the KF412.

One of the most successful Police counter-insurgency units during the Border War was the South African Police unit known as Koevoet. From their inception in Ĩ979 until being disbanded in İ989 they recorded more than ĩ 600 contacts. Their operational vehicle was the Casspir.

Roelf Maritz joined Koevoet in the latter part of Ĩ980 and from 198İ until the end of Ĩ982 he quite remarkably survived five landmine incidents while travelling in a Casspir. Roelf takes up the story…

I survived the ride

We had been on a week's deployment in the bush, working the areas between Okankolo, Elundu and Eenhana. Eager to get back to our base at Oshakati, we decided to leave early in the morning before the SA Army sappers had swept the road for mines. My Casspir was fourth in the convoy. I was following in the tracks of the three Casspirs ahead of me with a safe distance and the last thing on my mind was hitting a landmine.

Suddenly an ear-deafening bang, a blinding flash, then smoke and dust. My Casspir reared up in the air like a bucking bronco while still moving forward, then just as quickly, the front end plummeted down and the vehicle came to an abrupt stop.

With ringing ears, black faces, smoke and dust hanging heavily in the air, we got out of the vehicle – after carrying out anti-ambush drills – to assess the damage. Our front right wheel had detonated a TMA-3 'cheese' anti-tank mine. Apart from the tyre being blown to pieces, there was very little damage to the Casspir. We prised the twisted steel rim off the hub, fitted the spare wheel and continued with our trip to Oshakati, towing the Casspir. I suffered a few minor lacerations to my head. No one else was injured.

The next incident happened east of Elundu. We had been following the tracks of four insurgents for several hours before realising that two of the Casspirs needed urgent repairs. It was getting dark and I decided that we should try to get back to Elundu while it was still light. To speed up our return trip in the fading light we decided not to bundu-bash but to follow the tracks we had made earlier in the day. As a rule, Koevoet did not back-track in its tracks. We were making steady progress when suddenly there was a loud explosion and a blinding flash, followed by thick smoke and sand and my Casspir was blown into the air.

Judging from the massive size of the blast crater and the damage to my Casspir, which I noticed was more severe than my previous landmine explosion a month earlier, I believe that this mine had been 'boosted'. It was aTM-57 anti-tank mine that blew off our left front wheel. Again, apart from the minor bumps and bruises there were no injuries to any of my men.

The third, fourth and fifth incidents all happened while bundu-bashing in pursuit of insurgents deep in the bush far from any base or road. In all three of these TM-57 anti-tank mine incidents there was no injury to personnel nor structural damage to my Casspirs. Our fighting tactics were such that we often stood up on the seats while in a contact, engaging the insurgents from inside the Casspir. This meant that seldom was anyone strapped in, yet when we did strike a mine there was seldom injury to personnel. This is testament to what a remarkably well-designed landmine-protected vehicle the Casspir was.

I can say without a doubt that the Casspir, as far as I'm concerned, is the best mine-protected vehicle ever built!

21B
21B
21A
21

Chapter 4

1980s, MINE-PROTECTED VEHICLES SAVE MANY LIVES DURING THE HEIGHT OF THE BORDER WAR

By the latter part of the 1970s, the scientists and engineers had drawn on the practical experience of the Army and Police, leading to the first purpose-built mine-protected vehicles. Two became icons of the Border War, the Buffel and the Casspir. The first was effective and saved lives, but was high, had an uncomfortable ride – downright scary going around a corner quickly – and was prone to falling over when detonating a mine under a wheel.

The Casspir was the first monocoque mine-protected vehicle, its lower centre of gravity translating into less body roll, and was also heavier, the combination damping the effect of a blast and making it unlikely to fall over. Its monocoque structure also lent itself to quick repair in the field, as the wheel stations were fastened to the hull, with no chassis for the blast to distort. The greater weight and power also enabled it to bulldoze its way through quite heavy bush.

They were soon followed by mine-protected cabs for logistic and recovery vehicles and for some civilian vehicles, allowing them to move safely along potentially mined roads, and for vehicles such as road graders.

There is good reason why the SAMIL (South African Military Vehicle) is regarded as one of the finest off-road support vehicles in the world. It was a purpose-designed logistic support vehicle that offered outstanding mobility, capable of negotiating all types of adverse terrain, while being able to remain operational for extended periods of time even under the harshest operational conditions of southern Angola and SWA.

KWÊVOËL

During the 1970s, the SADF had managed to standardise its soft-skinned cargo and personnel transport vehicles from around 30 different types in service in the 1960s, to 66% of all SADF vehicles being either the Land Rover, Unimog or Bedford. It was obvious with the escalating border conflict that these vehicles could not support the operational requirements unique to that theatre of war. The SADF tasked Armscor to look around for suitable replacements, ideally a family of military vehicles in the two, five and ten ton range.

Logistic vehicles form a vital component of any military force, being needed to transport personnel, ammunition, fuel, water and all the various stores and supplies that allow an army to remain operational, giving them the fighting edge in combat. These vehicles have to be reliable, often over a far longer time scale than their civilian counterparts.

Iveco, a European consortium, had developed a military vehicle and was competing against Mercedes for a NATO contract of similar military requirements to the South Africans. Iveco offered their vehicles to Armscor, who, together with the SADF, evaluated these vehicles in the late 1970s. It was soon clear that having been designed for European conditions, they would not stand up to the drier, dustier, muddier and rougher conditions of southern Africa without considerable modifications.

Armscor experts decided that these vehicles were the best options available to them at the time and, with a bit of local re-engineering, could up-spec them to suit the SADF’s requirements. Things were progressing well until NATO stepped in and disallowed the sale owing to the UN-led international arms embargo, forcing South Africa to go it alone in their quest to find a suitable logistic military vehicle that would meet all their criteria.

That led to the development, beginning in 1979, of a programme to design and manufacture a family of military vehicles, based on the design of the Magirus Deutz models, to be called SAMIL – South African Military Vehicle. The SAMIL range of vehicles had to be completely immune to international arms boycotts. To achieve this, there had to be a progression until the SAMILs were one-hundred-percent South African-manufactured, which by 1986 they were.

The initial SADF requirements for the SAMIL vehicles were for soft-skinned vehicles, and not for mine protection. With the landmine threat ever-present in SWA and Angola, mine-protected cabs were developed for the SAMILs. The cab was fitted with bulletproof glass and a roof ring fora light machine gun. These mine-protected logistic vehicles in the five- and ten-ton range were called the *Kwêvoël, the* Afrikaans word for a Grey Lourie bird.

The first SAMILs that entered service with the SADF were known as Mark I, followed by the Mark lls, introduced from 1984. The major difference was that the SAMIL Mk I had the imported Magirus Deutz air-cooled diesel engine, while the Mk II had the locally manufactured Atlantis diesel engine (ADE), which was water-cooled. The ADE engine ensured that the SAMIL family of vehicles was completely immune to international sanctions. The specifications for both marks of the 100, 50 and 20 SAMILs were very similar.

Kwêvoël cabs for the SAMIL-100 and -50 were produced and mounted on various body configurations, including cargo, fuel bowser, water tanker, recovery vehicle, troop transporter, mobile workshop, horse transporter, tip truck, ambulance and many other variants.

Various configurations of mine-protected vehicles were also developed and produced on the SAMIL-20 chassis. These included a cargo, troop transporter, and a 20 mm antiaircraft gun system in different variants.

This very unique South African designed military truck, the SAMIL Kwêvoël series of logistic vehicles, proved to be amoung the safest mine-protected vehicles at that time owing to their weight, height off the ground and excellent cab design. They could withstand the simultaneous detonation of three TM-57 landmines or the equivalent of 21 kg of TNT explosives anywhere below the cab. As the SAMIL Kwêvoëls were so well protected, driving in the bush presented no problem.

Many thousands of kilometres were covered through dense savannah bush, under extremely high temperatures and in very soft sand. On many occasions the payload of the SAMIL-100 Kwêvoël was more than 13 tons, especially when carrying the heavy G5/G6 artillery ammunition, yet these reliable workhorses never failed to deliver their cargo to the fighting forces on time. During the 1987/88 campaign in Angola the logistic route was so rough that some of the pallets for spare tank engines punched through the floor of the SAMIL-100 load bed.

There are records of some of the first SAMILs off the production line in the early 1980s that were still serviceable in the early 2000s having clocked up over a million kilometres.

It's interesting to note that Armscor also developed bush protection kits for the SAMIL-100 and -50 soft skin vehicles. Air, fuel and hydraulic lines were tucked into the chassis and bush bars and plastic fuel tanks were fitted. These vehicles brought about significant cost savings during bush driving.

There is no doubt that the mine-protected variants of the SAMIL range of vehicles saved many lives, which ensured high morale amongst the logistic vehicle drivers who would often drive alone in extreme crosscountry driving conditions in southern Angola to keep the supply lines open. Towards the last few years of the Border War the logistic supply line was an approximate 1200 km round trip into southern Angola to keep the SA Army forward operating bases stocked with supplies.

When the production of SAMIL vehicles was terminated towards the end of 1992, approximately 60 different variants had been derived from the SAMIL including the SAMAG and SAKOM non-military vehicles and no fewer than 16 864 SAMIL, SAKOM and SAMAG vehicles were built by a number of truck makers around South Africa. Many of the SAKOM vehilces were also bought by the SADF for use in rear areas, where the 4x2 (Sakom-70, based on the Samil-50) 6x4 (Sakom-120, based on the Samil-100) drivelines were adequate.

Although designed and built during the 1980s, the SAMILs, together with the many Kwêvoël variants, still remain in use with the 21st century SANDF. The plans to modernise the fleet of logistic trucks have been delayed. Other SAMIL-50s and SAMIL-100s are serving in Somalia with the Ugandan Army.

The cargo carrier version has a crane with a 1.2 ton capacity.

SAMIL-100 Kwêvoël
The SAMIL-100 Kwêvoël was a 6x6 genuine off-road workhorse capable of transporting a 10 ton payload almost anywhere. This ten ton mine-protected cab was offered in over 24 different variants. The rear part of the Kwêvoëls were built in wrought-iron steel attached to the chassis by a suspension that gave the truck great flexibility in off-road conditions. All the specifications given below are mostly the same for all the SAMIL-100 Kwêvoël variants shown here as they were on the same chassis.

SPECIFICATIONS

Crew:

Single cab	1 + 1
Double cab	2 + 3

Dimensions:

Length	10 873 mm
Width	2 500 mm
Height	3 025 mm
Wheel base	5 940 mm
Ground clearance	355 mm

GVM:

Mass with no load	12 220 kg
Mass with load	22 786 kg

Protection level:

Triple TM-57 and small-arms fire

Engine:

Type FIOL 413 V10 air-cooled 4-stroke Deutz diesel with direct injection.

Engine output: 200 kW @ 2 650 rpm

Transmission:

Synchronised 6 speed gearbox S6-90 (ZF)

Transfer Box:

Two-shaft transfer case. Drive via transfer case with pneumatically lockable planetary differential gear.

Axle type:

Front – Banjo-type drive axle with steerable stub axles.

Back – Banjo-type drive axle with flanged-on axle tubes. Pneumatically lockable bevel differential gear and axle shafts to the planetary gears in the wheel hubs.

Electrical system: 24 volt system

SAMIL-100 Kwêvoël Mk II A Cargo Drop Side

Role: Transportation of cargo.
Quantity manufactured: 235 for the SADF
First year of manufacture: 1984

SAMIL-100 Kwêvoël Mk IIA Cargo Drop Side with Crane

Role: Transportation of cargo. Fitted with a 6 ton crane.
Quantity manufactured: 443 for the SADF
First year of manufacture: 1984

SAMIL-100 Kwêvoël Mk II A Personnel Transporter

Role: Transportation of 36 people.
Quantity manufactured: 7 for the SADF
1 for the SWA Department of Water Affairs
First year of manufacture: 1984

SAMIL-100 Kwêvoël Mk II A Water Tanker

Role: Transportation of 9 100 litres of water.
Quantity manufactured: 69 for the SADF
First year of manufacture: 1984

SAMIL-100 Kwêvoël Mk II A Fuel Tanker

Role: Transportation of 10 500 litres of fuel.
Quantity manufactured: 168 for the SADF
First year of manufacture: 1984

SAMIL-100 Kwêvoël Mk II A Tipper

Role: General construction work.
Quantity manufactured: 21 for the SADF
First year of manufacture: 1984

SAMIL-100 Kwêvoël Mobile Observation Tower

Role: Observation platform.
Quantity manufactured: 12 for the SADF
Crew: Driver, co-driver plus three personnel.
First year of manufacture: 1984
Operation: There were four corner-mounted hydraulically operated platform stabilising legs as can be seen in the photograph. There was a built-in inclinometer that automatically signalled the stabilising legs for the final adjustment of the platform (about 3° for both horizontal axis). The scissor legs also operated hydraulically but only once the platform had been levelled. The platform could be adjusted to any height up to a maximum of 10 metres above ground level. Note the double mine-protected cab.

SAMIL-100 Kwêvoël Mk II A Articulated Truck

Role: Transportation of cargo on attached trailer.
Quantity manufactured: 2 for the SADF
1 for the SWA Department of Transport
First year of manufacture: 1984

SAMIL-100 Kwêvoël Mk I Cargo Drop Side

Role: Transportation of cargo
Quantity manufactured: 42 for the SADF
2 for the SWA Department of Water Affairs
First year of manufacture: 1981
The chassis was the Magirus Deutz 232 with a F8L 413 air-cooled engine.

SAMIL-100 Kwêvoël Mk I Fuel Tanker

Role: Transportation of 13 000 litres of fuel.
Quantity manufactured: 20 for the SADF
First year of manufacture: 1981
The chassis was the Magirus Deutz 232 with a F8L 413 air-cooled engine.

SAMIL-100 Kwêvoël Mk I Horse Transporter

Role: Transportation of horses to outlying SADF equestrian units.
Quantity manufactured: 6 for the SADF
First year of manufacture: 1981
The chassis was the Magirus Deutz 232 with a F8L 413 air-cooled engine.

Note: While the cab was protected against both landmines and small-arms the horses in the transporter were only protected against landmines.

SAMIL-100 Kwêvoël Mk I Tipper

Role: General excavation work.
Quantity manufactured: 1 for the SWA Department of Water Affairs
First year of manufacture: 1981
The chassis was the Magirus Deutz 232 with a F8L 413 air-cooled engine.

SAMIL-100 Kwêvoël Mk IIA Refrigerated Pantry

Role: Designed to carry perishable freight at specific temperatures.
First year of manufacture: 1986

Note: There are ongoing upgrades to the cooling units. In some cases when the old unit is removed it is found that the support frame is no longer serviceable, in which case the refrigerated pantry body has to be replaced with a new one. The front compartment has a carrying capacity of 2 000 kg and the rear compartment 850 kg.
Temperatures from -20° C to +20° C can be selected for the front compartment to suit the specific freight while the rear compartment is pre-set at +4° C to +2° C. A one-piece, front-mounted, high-capacity, clean and silently operating diesel-powered engine cooling and heating system is used. It is designed for use with totally chlorine free R-404a refrigerant.

SAMIL-100 Kwêvoël Mk IIA Bateleur Multi Rocket Launch System

Role: Mobile artillery rocket launch system.
Quantity manufactured: 25 for the SADF
First year of manufacture: 1989 See page 223 for more information.

Role: Field maintenance and repair vehicle.
First year of manufacture: 1989

Note: This field maintenance and repair workshop vehicle is equipped with special tools for the field repair of most of the combat vehicles operated by the SADF such as the Olifant tank, Ratel and Rooikat armoured vehicles and trucks, their engines, transmission and other units and systems. This includes diagnostic equipment, special maintenance and repair tools and devices designed for use in this mobile field workshop. This vehicle is known as the *Waterbok*, Afrikaans for waterbuck.

SAMIL-100 Kwêvoël Mk II A Field Maintenance and Repair

A variation of the SAMIL-100 Kwêvoël Mk II A Field Maintenance and Repair is shown here in a different configuration with a longer cargo bay to take on bulky spare parts.

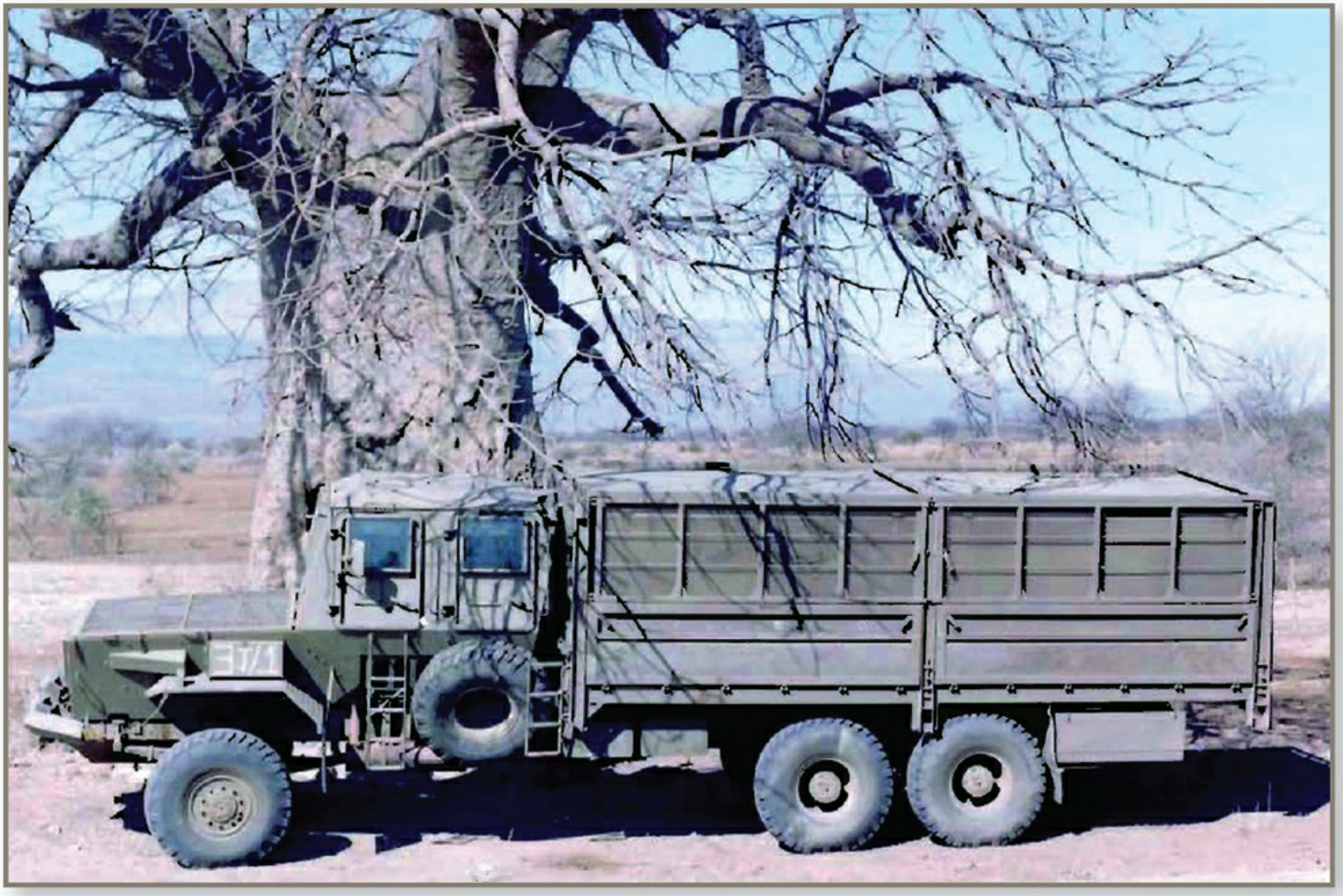
SAMIL-100 Kwêvoël Mk IIA Mirell Roll Mat

Role: Roll mat for use in adverse soil conditions.
First year of manufacture: 1985

SAMIL-100 Kwêvoël Mk IIA Medical Field Resuscitation Unit

Role: Mobile field medical resuscitation.
First year of manufacture: 1991

Note: The double cab caters for a crew of five: driver, co-driver and three medical staff. The rear configuration allows for four beds and everything that a small medical field resuscitation unit would require, such as portable oxygen and a range of medical supplies, all easily available in a cabinet of pullout box draws.



SAMIL-100 Kwêvoël Mk IIA Barge Transporter

Role: Transport barge equipment.
First year of manufacture: 1985

SAMIL-100 Kwêvoël Mk IIA Pontoon Transporter

Role: Transport pontoon sections.
First year of manufacture: 1985

SAMIL-100 Kwêvoël Mk IIA Bosvark AntiAircraft Defence System

Role: The mounted 23 mm Russian antiaircraft guns were used for static defence of high value targets or protection against air attacks from low flying aircraft or helicopters while on mobile operations. It can also be used in a fire support role.
Crew of five, driver, co-driver and three personnel.
Quantity manufactured: 36 for the SADF
First year of manufacture: 1999

SAMIL-100 Kwêvoël Mk IIA Withings Recovery

Role: Anti-landmine medium recovery vehicle in the 6 000 kg to 20 000 kg casuality mass category, to recover 10 ton SAMIL and Ratel vehicles.
First year of manufacture: 1985

SAMIL-100 Kwêvoël Mk IIA Withings Recovery

Role: Medium recovery vehicle in the 6 000 kg – 20 000 kg casualty mass category, but specialising in recovering the Ratel operated by the SANDF.
First year of manufacture: 1984

Note: These SAMIL-100 Kwêvoël recovery vehicles were both known as *Withings* which is the Afrikaans word for White Stallion. They were the backbone of the South African Army operating in southern Angola for the South African Technical Services Corps who kept the vehicles operational.

SAMIL-100 Kwêvoël Mk IIA Mobile Battery Fire Control Post and Early Warning Radar

Role: Multifunctional; 12 metre mast provides a surveillance radar designed to provide early warning to air defence artillery troops in the field. Support to the SAAF in providing radar coverage at remote airfields for airspace management/air traffic control functionalities.
Quantity manufactured: 2 prototypes for the SADF
First year of manufacture: 1990

SAMIL-50 Kwêvoël
In the 5 ton range of the mine-protected vehicles, the most popular versions were the cargo and water tanker. The specification of all these variants are mostly similar as they were mounted on the same chassis.

SPECIFICATIONS

Dimensions:	
Wheel base	4 900 mm
Length	7 853 mm
Width	2 450 mm
Height	3 025 mm
Ground clearance	355 mm

GVM:	
Mass with no load	9 070 kg
Mass with load	12 400 kg

Engine:
Type F6L413F air-cooled 4-stroke Deutz diesel with indirect injection.

Engine output:
141 kw (192 Flp) @ 2 500rpm

Gearbox:
Synchronised 6-speed gearbox S6-65 (ZF)

Transfer Box:
Two-shaft transfer case. Drive via transfer case with pneumatically lockable planetary differential gear.

Axle type:
Front – Banjo-type drive axle with steerable stub axles.
Rear – Banjo-type drive axle with flanged-on axle tubes. Pneumatically lockable bevel differential gearbox and axle shafts to the planetary gears in the wheel hubs.

Electrical system: 24-volt system

Top Speed: 93 km/h

Fuel tank capacity:
400 litres with an range of 1 000 km.

SAMIL-50 Kwêvoël Mk II Cargo Drop Side

Role: Transportation of cargo.
Quantity manufactured: 1 prototype for Armscor
2 for SWA Department of Water Affairs
1 for SWA Department of Post and Telecommunications
5 for SWA Department of Transport
1 for SWA Roads Department
First year of manufacture: 1981

SAMIL-50 Kwêvoël Mk II Recovery

Role: Anti-landmine recovery vehicle.
Quantity manufactured: 20 for the SADF
1 for the SWA Department of Transport
First year of manufacture: 1981

SAMIL-50 Kwêvoël Mk II A Cargo Drop Side

Role: Transportation of cargo.
Quantity manufactured: 158 for the SADF
First year of manufacture: 1984

SAMIL-50 Kwêvoël Mk II A Drop Side with Crane

Role: Transportation of cargo.
Quantity manufactured: 50 for the SADF
First year of manufacture: 1984

SAMIL-50 Kwêvoël Mk II A Water Tanker

Role: Transportation of 4 200 litres of water.
Quantity manufactured: 40 for the SADF
First year of manufacture: 1984

SAMIL-50 Kwêvoël Mk II A Fuel Tanker

Role: Transportation of 4 500 litres of fuel.
Quantity manufactured: 1 for SWA Police
First year of manufacture: 1984

SAMIL-50 Kwêvoël Mk II A Ambulance

Role: Transportation of patients.
Quantity manufactured: 2 prototypes for the SADF. It never went into production.
First year of manufacture: 1982

Note: Crew total of 10, driver, co-driver, 8 patients (4 lying) and 2 medical officers.

SAMIL-50 Kwêvoël Mk II Troop Carrier

Role: Transportation of troops and patrol work.
Quantity manufactured: 1 for blast testing
1 for Department of Water Affairs
1 for SWA Roads Departemnt
3 for SWA Department of Transport
3 for SWA Post and Telecommunications Department
First year of manufacture: 1981

Note: Crew total of 16, driver, co-driver, 14 in the rear.

SAMIL-20 Kwêvoël
In the 2 ton range there was a wide variety of mine-protected vehicles developed. Most in this size though ended up as prototypes and in some cases small production runs. The specification of all these variants are mostly similar as they were mounted on the same chassis.

SPECIFICATIONS

Dimensions:	
Wheel base	2 900 mm
Length	5 340 mm
Width	2 350 mm
Height	3 200 mm
Ground clearance	460 mm

GVM:

Mass with no load	5 790 kg
Mass with load	7 700 kg

Engine:

Type F6L 913 air-cooled 4 stroke Deutz 6 cylinder with direct injection.

Engine output:

79 kw @ 2650 rpm (derated)

Gearbox:

5-speed constant-mesh gearbox S5-35/2.

Transfer Box:

Two-shaft transfer case z-65
Drive via transfer case with pneumatically lockable planetary differential gear.

Axle type:

Front and rear – portal driving axle with pneumatically lockable differential with portal spur gear set.

Electrical system: 24-volt system

Top Speed: 94 km/h

Fuel tank capacity:

200 litres with an range of 900 km

SAMIL-20 -1 -Man Cargo Vehicle

Role: Transportation of cargo and various containerised systems.
Crew: Driver only.
Quantity manufactured: 1 for SADF
First year of manufacture: 1983

SAMIL-20 Rhino – 4-Man Vehicle

Role: Patrol, reconnaissance or command vehicle with packing and cupboard space, and sleeping facilities for one person.
Crew: Driver, co-driver and two men.
Quantity manufactured: 1 prototype for the SADF
First year of manufacture: 1983

SAMIL-20 Rhino – 7-Man Vehicle

Role: Patrol, reconnaissance or command vehicle with load bay at rear of vehicle for 150 kg storage.
Crew: Driver, co-driver and five men.
Quantity manufactured: 1 prototype for the SADF
1 for SWA Administration

SAMIL-20 Rhino – 9-Man Vehicle

Role: Patrol, reconnaissance and command vehicle.
Crew: Driver, co-driver and seven men.
Quantity manufactured: 34 for the SAAF
11 for SWA Administraion
1 for Rand Water
1 for Bophututaswana Intelligence
1 for Hartsfontein Gold Mine
2 for the Johannesburg City Council
2 for Lorrain Gold Mine
7 for Goldfields
First year of manufacture: 1983

SAMIL-20 Kwêvoël Cargo

Role: Transportation of cargo.
Crew: Driver and co-driver.
Quantity manufactured: 1 for the SADF
3 for the SWA Administration
First year of manufacture: 1983

R 63098

Rhino

Role: Transportation of troops and patrol work.
Crew: Driver, co-driver and five men.
Quantity manufactured: 20 for the SAAF
First year of manufacture: 1983
Comments: After Project Sireb came to an end, Armscor developed the Rhino landmine-protected vehicle on its own initiative.

The Rhino was based on the SAMIL-20 components and similar to Kiewiet I except it had a fully enclosed troop compartment including the driver's cab built on a V-shaped hull. The SAAF used the Rhino to fulfil the role of an airbase defence vehicle. It had two square hatches in the roof, one towards the middle of the troop compartment and the other at the front above the cab of the co-driver's seat. Its spare wheel was mounted on the rear in between two armoured glass windows. It had a mount option for a machine gun. There were firing ports below the crew windows. Access was gained by a short ladder to cab doors on both sides of the vehicle.

Two decades later, once these vehicles were no longer in use by the SAAF, they were in high demand for use in various humanitarian demining activities around the world as well as performing security tasks at various mines.

AFP 951 T

Two vehicles were presented to the SA Army during 1981/2 for evaluation against the requirements of Project Sireb. Both vehicles were based on the SAMIL-20 components. The first vehicle designated as the Kiewiet I, was developed by Armscor and consisted of a mine-protected capsule connected to a SAMIL-20 chassis.

KIEWIET AND WILDEBEES

The second vehicle (below), called the Wildebees I, was developed by the Chemical Defence Unit of the CSIR. This vehicle was also based on SAMIL-20 components, but a monocoque approach was followed.

14

Both vehicles were evaluated against a Buffel Mk IB. During a very thorough evaluation programme, which included landmine-protection testing, it was concluded that neither of the vehicles performed better than the Buffel, or for that matter, could cost effectively replace the Buffel.

From left, the Kiewiet II, Bulldog and Wildebees II.

PROJECT SIREB

Project Sireb was created in 1981 and from it emerged two improved versions of Kiewiet I and Widebees I, called Kiewiet II and Wildebees II, which were presented to Armscor in 1983 again as possible replacements for the Buffel. The vehicles were essentially the same in comparison to Kiewiet I and Wildebees I, although SAMIL-30 axles, imported from Egypt, were used in both cases.

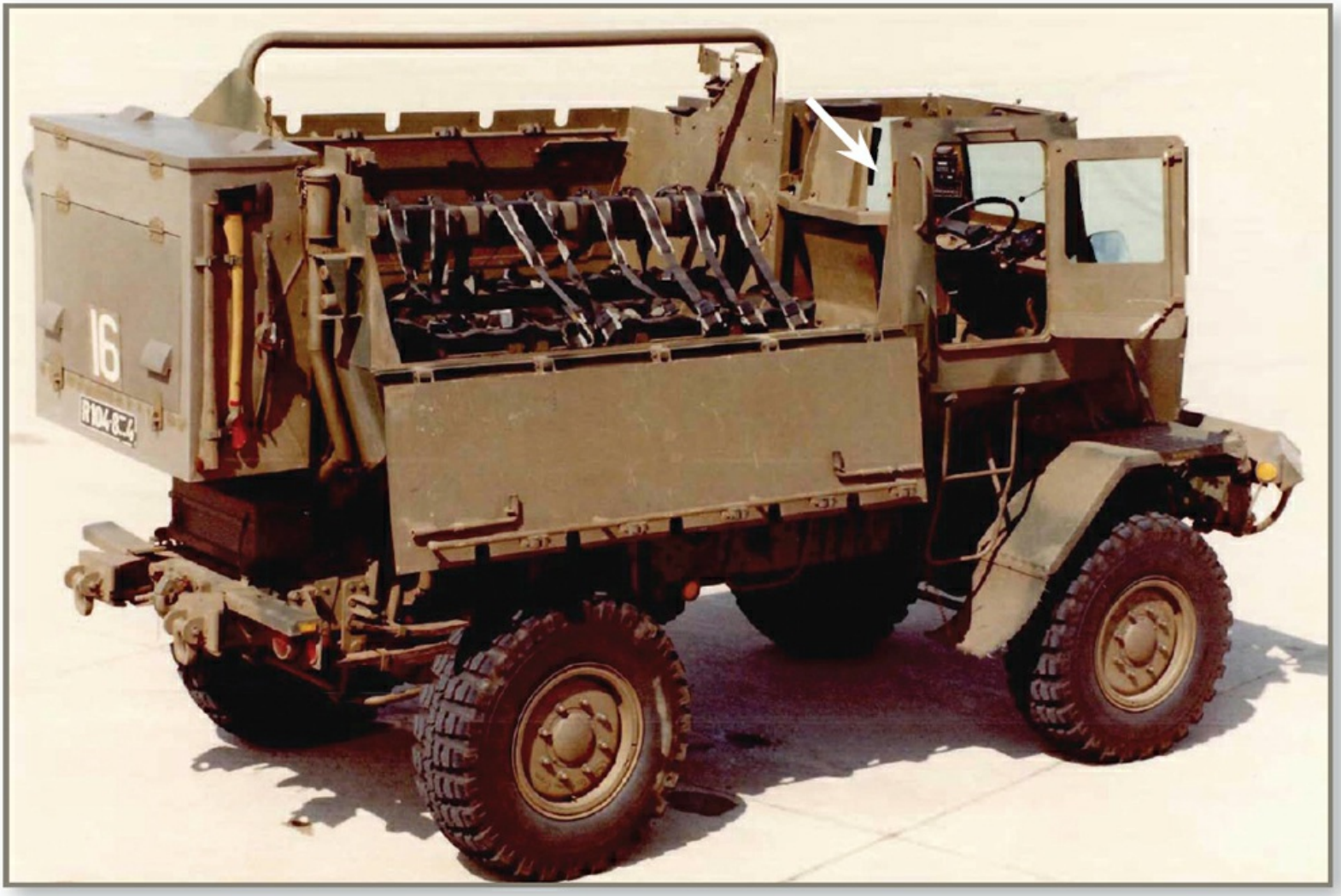
A third vehicle was also offered, called the Bulldog, which was basically a Buffel-type layout on a SAMIL-20 chassis. The vehicles were again evaluated against the Buffel Mk IB, and again the conclusion was reached that not one of the vehicles could cost-effectively replace the Buffel. The Bulldog was utilised by the SAAF for patrolling airfields. A variant called the Ystervark was produced and used in the antiaircraft role. See page 222 for more information.

SAMIL-20 Kiewiet MK II.

SAMIL-20 Ystervark with 20 mm anti-aircraft gun.

SAMIL-20 Bulldog

Developed as a possible successor to the Buffel. Visually very similar, except being right-hand drive with a different engine housing sitting more centrally on the chassis. A further difference was the driver's cab being incorporated into the troop compartment, as can be seen in the middle photograph. There was provision for two mounted MGs front and rear.


16

R104 834

A Buffel landmine-protected vehicle detonated a British Mk VII mine on the 6 January 1983, during an operation in southern Angola. In the blast, the diesel tank was penetrated, causing a severe fire in which there were a number of fatalities. As a result Project Remark was approved on 23 March 1983 that entailed the development of a concept vehicle that could provide improved protection against this threat, with a view to possibly replacing the Buffel. This resulted in the development of four prototype concept vehicles that were thoroughly tested over a period of a year. Project numbers, 31, 32, 33 and 34 were given to each of the vehicles for the duration of the field testing, while the Buffel, against which these concept vehicles were benchmarked, was designated project number 35.

PROJECT REMARK

The design priorities for Project Remark were protection of personnel, mobility, protection of engine and working components and fighting ability.

The mine-protection requirements were to provide protection to the occupants with the vehicle travelling at 35 km/h against:a single British Mk-7 mine with an additional booster charge of 0.5 kg TNT, three ‘coupled’ TM-57 mines, a ‘Bril’ (two mines either next to or above another) and a double ‘Bril’ mine.

In addition to this, the main aggregates (engine, gearbox etc) were to be protected against the detonation of at least a double TM-57 or a single ‘Bril’ mine detonation.

Ten companies were approached with the following four companies presenting their concept vehicles:

The SAMCOR vehicle (Remark 31) used the Ratel-type axles, leaf springs and a manual gearbox. The engine and gearbox were situated in the middle of the vehicle below the crew seats, driving through a transfer box at the rear of the vehicle and through the rear axle to the front axle. The rationale behind this arrangement was that as mines are mostly detonated by the front wheels, the cost per detonatation would be cheaper as the main aggregates would remain undamaged. It had a combat mass of 14 820 kg, ground clearance of 420 mm and height of 3 157 mm. It had a semi-opened troop compartment with back-to-back seating.

31

The TFM vehicle (Remark 32) was conventionally arranged with the engine (ADE 352TI) and torque converter in the front and the ZF 6WG180 gearbox situated in the middle of the vehicle. Mercedes Benz APL axles with parabolic leaf springs were fitted. It had a combat mass of 12430 kg, ground clearance of 420 mm and a height of 3 119 mm. Troops sat back to back in a semi-opened compartment.

32

32
R 1164406

The Magnis vehicle (Remark 33) made use of SAMIL-50 Mk II components and was fitted with an ADE 409 N engine coupled to a ZF S6-65 gearbox via a Z65 transfer case. Standard SAMIL-50 axles and suspension components were used. It had a combat mass of 14 945 kg, ground clearance of 355 mm and a height of 3 211 mm. It had an enclosed troop compartment with back-to-back seating.

The Dorbyl/Sandock Austral vehicle (Remark 34) made use of Ratel components, whilst an ADE 407T engine and ZF S5-111GP manual gearbox were integrated into a power pack which was situated between the front and rear crew compartments.It had a combat mass of 15 900 kg, ground clearance of 420 mm and a height of 2 988 mm. It had an enclosed troop compartment with back-to-back seating.

34

The concept vehicles ranged from a relatively cheap, simple, practical vehicle in the form of what was called the Nyala (Remark 31) with leaf spring suspension to a very expensive and technically much more complex Dorbyl/Sandock Austral (Remark 34) vehicle with coil spring mounted hub reduction axles similar to the Ratel. This vehicle went into production and was marketed as the Mingwe in the military version and the Ingwe for the civilian version. Unfortunately there was little demand with the SA Army purchasing six while a few Ingwes were sold to mining companies. Both variants are covered in more detail on page 76.

Interesting frontal comparison of the Ratel, Remark 34 (Mingwe) and Buffet.

The unique characteristics of all these vehicles was the construction of the monocoque hulls using RB390 armour steel, instead of the traditional ROQ-tuf, to provide adequate protection against the British Mk-7 mine. The vehicles were evaluated during a thorough twelve months of testing and evaluation, in which all of them performed very well, meeting most of the laid down requirements. It was eventually decided that the best features would be combined into a single vehicle, thus Project Remark and Project Addax were combined into a new project called Velskoen, which is covered in more detail on page 74.

Field testing all the Remark concept vehicles in SWA. Left to right, Buffel, Remarks 34, 33, 32, 31 and a Casspir.

Interesting comparison of the vehicles profiles and sizes, left to right, Ratel, Remarks 31, 32, 33, 34 and Buffel marked as 35.

The Velskoen 4x4 vehicle was the result of combining Project Remark and Addax. The purpose of Project Velskoen was to develop a landmine-protected family of vehicles in different variants that could be used in both the counter-insurgency and conventional roles.

VELSKOEN

The landmine-protected requirements for the Velskoen vehicle were the detonation of a triple TM-57 mine under any wheel or the detonation of either a double TM-57 or a single 'Bril' mine under the hull would not result in any deformation of the hull. The vehicle had to be repairable by a mobile light workshop team in less than two hours.

Two Velskoen 4x4 prototypes were built. The first was configured as a section carrier and was later modified to artillery and engineer reconnaissance variants. The second was built as a command vehicle.

A comprehensive evaluation indicated that the vehicles were reliable and conformed to the requirements, but the mass of the vehicle, especially on the front axle load, was unacceptable. The project was terminated on the 12 November 1990 owing to the cessation of hostilities in Namibia and Angola.

Velskoen is the Afrikaans word for a leather shoe.

SPECIFICATIONS

Crew:	2+9

Dimensions:

Length	4 056 mm
Width	2 486 mm
Height	2 968 mm
Ground clearance	421 mm

Mass:

Combat	14 500 kg
Payload	3 500 kg

Performance:

Top speed	106 km/h
Gradient ability	60%
Turning circle	wall to wall, 17 500 mm
Range	on road, 800 km
	off road, 400 km

Protection Levels

Ballistic – 7.62 mm and 5.56 mm
Landmine-3 xTM-57 under any wheel, 2 x TM-57 under the vehicle.

The Velskoen was designed to be operational within two hours after a landmine incident.

Engine:

5-Cylinder in line, turbo charged with inter cooler.

Maximum torque – 1295 Nm @ 1 100 – 1 600 rpm

Maximum power – 230 Kw @ 2 100 rpm

Transmission:

6-Speed fully automatic with lock-up facility.

Suspension:

Coil springs and hydraulic double-acting shock absorbers.

Brakes:

Dual circuit pneumatic/hydraulic Foot-controlled exhaust brake

KRIMPVARK

Anticipating a need in the civilian market place for a small armoured vehicle to be used by farmers, security companies, local authorities, mining companies and other industries in high-risk areas in remote rural parts of South Africa, Koos de Wet and Bert Sabatier designed a range of vehicles based on the ordinary commercial 1 ton pickups available in the market place.

KRIMPVARK

Design work on the Krimpvark began in early October 1985 and was built by Afrit in Rosslyn, the marketing arm of Van de Wetering Engineerings contractor of Armscor.

The Krimpvark was available in either a three- or five-seater version.

A lot of attention was given to the comfort of the passengers in this civilian armoured vehicle. The cabin was air-conditioned and the whole interior carpeted. Ample entrance was provided by two safety doors, one on each side of the cabin and a rear door for the five-seater.

Emphasis was placed on removing the aggressive military appearance of the mine-protected cabin by providing a soft outward appearance. The cabin design of the Krimpvark ensured protection against antitank mines and small-arms fire up to 7.62 mm ball ammunition.

The Krimpvark was designed to be mounted on almost any make of pickup truck available in the market in South Africa at the time. It was a two-wheel-drive vehicle capable of a top speed of 110 km/h on tarred roads. It was offered in either a 2 litre petrol-driven engine or a 2.2 litre diesel engine. The big advantage of using a standard proven drive train was the ease of availability of the spare parts and servicing through national dealer networks. There were plans for future versions of the Krimpvark to include a four-wheel drive, three-seater with a load-carrying facility, but the Krimpvark sales were not as anticipated and only very few were manufactured and no further development was carried out.

Krimpvark is the Afrikaans word for hedgehog.

Sandock-Austral developed the Mingwe 4x4 vehicle as its submission test vehicle for Project Remark (vehicle 34, more details on page 72) and later, after a few modifications, a civilian version, the Ingwe for the South African commercial security market•The Mingwe had a V-shaped monocoque all-steel hull which allowed it to take two TM-57 anti-tank blast mines anywhere below the vehicle. It could carry 13 persons and used the same suspension as the Ratel with an ADE 366TI engine that could have either an automatic or manual gearbox fitted. Troops gained access through rear double doors while the driver and co-driver had a front door each. Along both sides of the hull were five bulletproof windows with firing ports. The rear doors also had two bulletproof windows. The seating was either back-to-back outward facing or facing inward with sidewall seating.

MINGWE AND INGWE

The SA Army ordered six Mingwe vehicles (three with manual and three with automatic gearboxes) during August 1986 to be evaluated as an interim vehicle under operational conditions. The Mingwes were used exclusively by 101 Battalion mostly on operations in southern Angola. The vehicles were later transferred to the then Far North Command for use on the northern border.

The Mingwe vehicles were used operationally by 101 Battalion in northern Namibia and on 'external operations' against SWAPO guerrillas in southern Angola. 101 Battalion was one of the most successful units and developed its own style of high-mobility operations, as well as often developing its own armament sets for its vehicles. This Mingwe has both a shielded 12.7 mm machine gun on the roof and provision for a 7.62 mm 'bow gun'.

The Reumech Mk II with the larger side windows, spare tyre stored under right belly and reduced number of roof hatches.

This vehicle was at the time considered to be one of the best balanced mine-protected vehicles ever developed, with excellent mobility characteristics and good levels of ballistic and landmine protection.

In the early nineties some of these vehicles were modified by Reumech Ermetek, which were known as the Mingwe Mk II. No further developments took place as the Casspir range was already in extensive use and the Mamba, which was expected to replace the Buffel, at an advanced prototype stage.

Ingwe is the Zulu word for leopard, while the *M* was for military, hence Mingwe.

The Ingwe.

SPECIFICATIONS

Crew:	1 + 11
Dimensions:	
Length	6 100 mm
Width	2 400 mm
Height	2 900 mm
Wheelbase	3 400 mm
Ground clearance	400 mm
Mass:	
Tare	11 000 kg
GVM	13 000 kg
Performance:	
Top speed	106 km/h

Grade ability	60%

Protection Level:

Ballistic – 7.62x51 mm and 5.56x45 mm.
Blast – 2 x TM-57 landmine anywhere under the hull or wheel.

Engine:

Make – ADE366
Configuration – 6-in-line
Maximum power – 100 Kw @ 2 800 rpm
Maximum torque – 408 Nm @ 1 400 rpm

Suspension:

Coil springs and hydraulic double-acting shock absorbers.

BDK 568B

ALBATROSS CARGO CARRIER

The Albatross was a 10 ton class cargo carrier developed by TFM for the SAP. These vehicles were used for many years in the 1980s to supply police stations and bases in the operational area, where there was a danger of mines on the mostly gravel roads. When the SAP handed over the operational area to the SADF, the Albatross vehicles were withdrawn from service.

SPECIFICATIONS

Crew:	1 + 1
Dimensions:	
Length	9 230 mm
Width	2 500 mm
Height	3 400 mm
Ground clearance	380 mm
Mass:	16.34 tons empty
Performance:	
Top road speed	95 km/h
Range	940 km
Gradient ability	29, 25°

Protection level:

All three variants had armoured and mine-protected cabs. The vehicles could withstand a double TM-57 landmine blast any where under the vehicle.

Engine:

Water-cooled diesel, delivering 206 kW.

Suspension: Leaf springs

Brakes: Dual-circuit air pressure

ABNORMAL/E LOAD/VRAG

Albatross Recovery Vehicle

The Albatross mine-protected recovery vehicle was developed on the basis of the Albatross cargo carrier. With both booms locked and fully retracted, it had a maximum vertical lift rating of 26 tons. The ratings for a single boom fully retracted and fully extended were 13 tons and 6 tons respectively.

Albatross Mechanical Horse

The Albatross armoured and mine-protected mechanical horse was used with a low-bed trailer to transport new Casspirs to the operational area and damaged Casspirs to the factory for repair or rebuilding.

12C
R105645

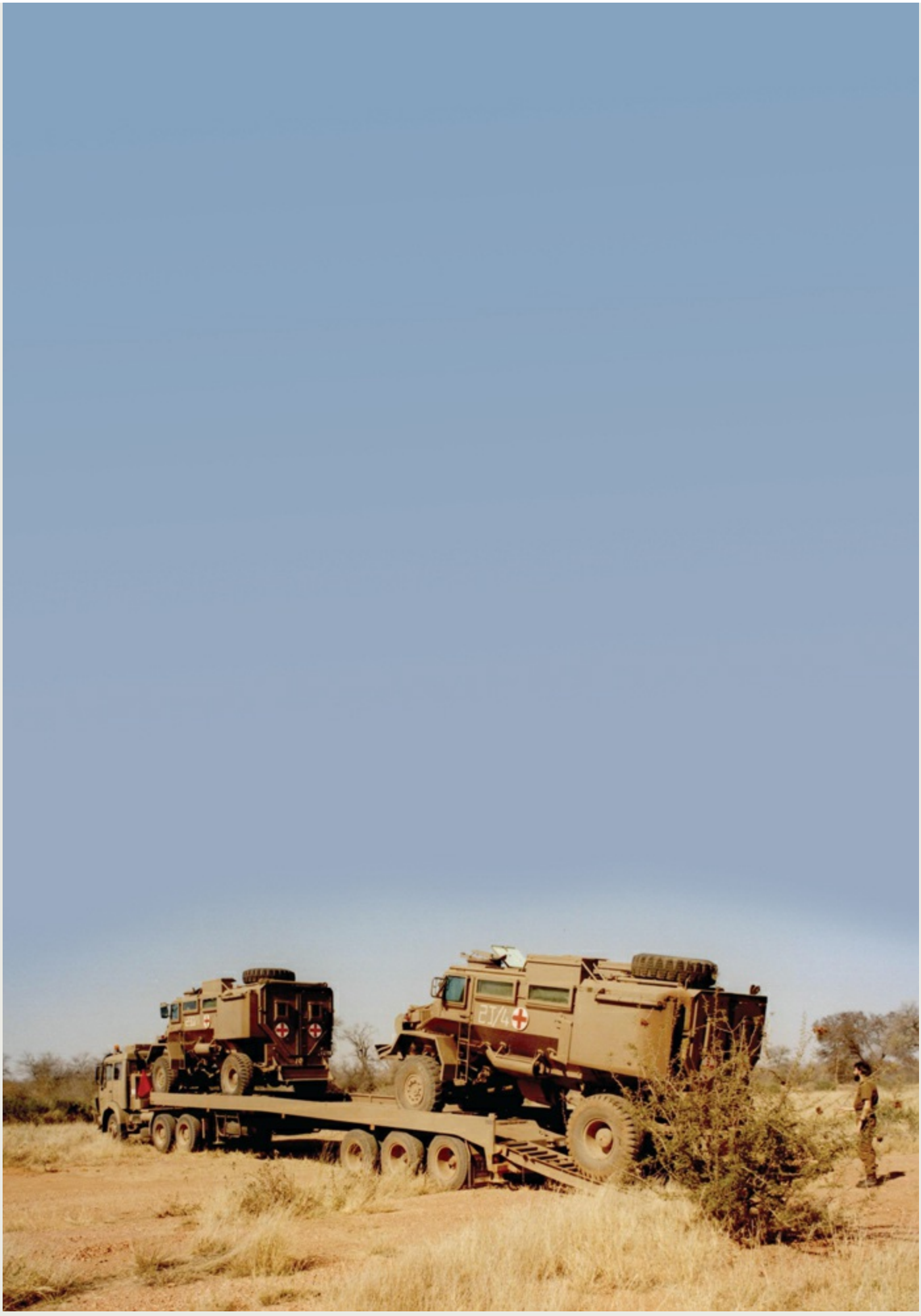
A variety of landmine-protected ambulances had been developed since the seventies, ranging from the Flossie prototype, based on the monocoque Hippo Mk II, to a Buffel Mk IA and a SAMIL-50, Kwêvoël. The latter was not acceptable to the South African Medical Services (SAMS) owing to its access height and the fact that the driver and co-driver were separated from the rest of the occupants.

RINKHALS AMBULANCE

The SAMS then contracted CSIR to continue the work on landmine-protected ambulances. This was known as Project Drift, through which the Rinkhals ambulance was developed. The vehicle used a monocoque approach and SAMIL-50 Mk I driveline and suspension components. Only 44 Rinkhals ambulances were manufactured during 1982.

The Rinkhals was the first monocoque mine-protected ambulance to betaken into service with the SADF in 1982 and in fact anywhere worldwide.

The Rinkhals was able to withstand a double TM-57 landmine blast anywhere under the vehicle. While this ambulance provided all the armour advantages of the Casspir, it had considerably more space, allowing for four stretchers, one guard and four to five more seats for staff or walking wounded. It had a full medical set-up of a field ambulance and was fitted with lockers for medical supplies, oxygen gear and various medical monitors.



The Flossie prototype landmine-protected ambulance awaiting restoration.

It could accommodate a crew often including a driver and co-driver. Access was either through two rear doors or two front doors of the cab. The passenger compartment could also be accessed from the crew compartment.

A hatch was positioned above the co-driver with a weapon mount. The spare wheel was mounted on the roof towards the rear of the vehicle. Like many other mine-protected vehicles designed by the South Africans operating in the harsh dry conditions, a 190 litre drinking water tank was fitted inside at the rear of the crew compartment for easy access.

The Rinkhals saw active service in many of the external operations carried out by the SADF.

Despite the Rinkhals providing excellent service and being replaced towards the end of 1980 with a new mine-protected ambulance called the Mfezi, three decades later the Rinkhals would be used as the field ambulance of choice in the conflict areas of the Middle East and Africa by the United Nations. It is also known that private security companies used this vehicle in Iraq and Afghanistan. A wonderful testament to the superb engineering skills of the South Africans in the 1980s; indeed a proven world-class mine-protected vehicle that has stood the test of time.

SPECIFICATIONS

Dimensions:	
Length	7 210 mm
Width	2 550 mm
Height	3 150 mm
Ground clearance	350 mm
Mass:	
GVM	13 000 kg
Performance:	
Top speed	100 km/h
Approach angle	34°
Departure angle	30°
Range	900 km

Protection level:

Blast – 2xTM-57 landmine anywhere under the hull or wheels.

Engine:

Fuel injected V-6 diesel, delivering – 141 kW at 2 50Û rpm; 502 Nm at 1 600 rpm.

Transmission:

Manual -6 forward gears and 1 reverse

Steering: Power assisted

Suspension:

Leaf springs with telescopic shock absorbers; stabiliser bars on rear axle.

Brakes:

Pneumatic system; exhaust brakes gear with high and low ratios.

The Soetdoring vehicle in 1981 was part of Project Illia's search for a new generation mine-protected vehicle. This monocoque hull vehicle, which used the same axles and suspension as the Ratel, was evaluated over the period August 1981 to April 1982, where it performed well. However, problems were experienced with the cooling system and transfer case, the ergonomic layout was deemed unacceptable and the front axle overloaded. No further development of the vehicle took place. It should be noted, however, that during the evaluation the vehicle survived in succession, a single, double and 'bril' type (one mine under the hull and the other under the right wheel) detonation. It could take 12 men with a driver and co-driver, had five outward-opening hatches above the enclosed troop compartment and a combat mass of 14 660 kg. *Soetdoring* is the Afrikaans word for sweet thorn.

SOETDORING

OKAPI

The Okapi 6x6 was developed in the late 1980s by Truckmakers (and later Reumech) to satisfy a SA Corps of Signals requirement for a landmine- and ballistic-protected vehicle that could be fitted with their electronic warfare equipment. The vehicle is similar in appearance to the Sealegs concept, but is longer with better mobility. It the 1990s another order was placed by the SA Army for the Okapi configured as a command and fire-control vehicle to support the SA artillery G-6 system. In mid-2001 the SA Army took delivery of nine mobile electronic warfare systems (EWS) as part of an extensive upgrade of its electronic warfare capability. This new EWS system was developed by Grintek Systems Technologies and installed into the existing Okapi vehicles.

OKAPI

The Okapi vehicle had a monocoque all-welded steel hull with the power pack installed at the front of the vehicle with the commander and driver being seated above and to the rear.

The commander and driver each had a forward-opening door with a bulletproof window in the upper part. In the right side of the hull was the operations compartment, which was separated from the crew compartment by a bulkhead. The roof hatch arrangement depended on the role of the vehicle. The axles incorporate hub reduction with pneumatically operated lateral differential locks.

A spare wheel was mounted at the rear of the hull on the right side and as with most South African mine-protected vehicles there was a 200 litre drinking water tank for soldiers in the field.

SPECIFICATIONS

Dimensions:	
Length	8 047 mm
Height	3 300 mm
Width	2 480 mm
Wheel base	2 645 mm
Ground clearance	480 mm
Mass:	
Tare	18 000 kg
Payload	4 000 kg
Performance:	
Top speed	100 km/h
Grade ability	60%
Range	on road, 900 km at 80 km/h
	off road, 400 km at 25 km/h

Protection Levels:

Ballistic – 5.56x46 mm and 7.62x51 mm.
Blast – 2 xTM-57 landmine anywhere under hull and 3xTM-57 landmine under any wheel.

Engine:

Type – ADE 447, TI, 6-cylinder

Maximum power – 294 kW at 2 100 rpm
Maximum torque -1 700 Nm at 1 000 – 1 600 rpm

Transfer box:

Allison HT 740, 4-speed automatic.

Project Addax came about in 1984 as a need to develop a new family of armoured

personnel carrier vehicles that could support the Ratel ICV. This family of vehicles would include a 4x4 landmine-protected vehicle to replace the Buffel, as well as 6x6 and 8x8 configurations.

AC 200

The vehicle that was derived from Project Addax was also referred to as the AC 200, and had a crew of three at the front of the vehicle, the engine in the centre, and a ten-man enclosed troop compartment at the rear. The driver sat on the right with a machine gun turret on his left and the commander's cupola behind the turret. Provision had been made to fit various turrets with either a 20 mm cannon or a 60 mm breech-loading mortar.

The AC 200 6x6 vehicle provided protection against the detonation of a single TM-57 mine anywhere below the monocoque hull, as well as the detonation of two TM-57 mines below any wheel.

The AC 200 was evaluated and not developed beyond a prototype as it was decided to save costs and combine Project Addax and Project Remark and to register a new project, Project Velskoen (see page 74).

SPECIFICATIONS

Crew:	3 + 10
Dimensions:	
Height	3 000 mm
Ground clearance	750 mm
Mass:	21 810 kg
Performance:	
Top speed	108 km/h
Range	1 000 km

Engine:

V-8 turbo-charged intercooled diesel, delivering 272 kWat 2 300 rpm.

Transmission: Automatic

Suspension:

Solid axles with progressively acting coil springs and hydraulic shock absorbers.

R 31163

The photo shows four engineers from Armscor who worked in the Mine-protected Vehicle Division managed by Koos Joubert. They are from left to right, Deon Nieuwoudt, Bernie Blaauw, Renier van Rensburg and André Coetzee. Frans Beetge (not in the photograph) was the programme manager.

BULPERD

The Bulperd was developed in 1983 as a heavy-lift recovery 6x6 vehicle. It had a double landmine-protected monocoque cab for a driver and crew of four.

A total of 11 were ordered by the SA Army for deployment into the operational area of SWA and on external operations into southern Angola where soft sand and heavy bush made the recovery of a damaged Ratel or Kwêvoël very difficult, requiring a particularly powerful vehicle.

SPECIFICATIONS

Crew:	1+4
Dimensions:	
Length	8 834 mm
Width	2 460 mm

Height	3 300 mm
Wheel base	5 334 mm
Ground clearance	350 mm

Mass:

GVM with no load	19 520 kg
GVM with load	25 600 kg
Permissible load	28 163 kg

Performance:

Top speed	95 km/h
Range	1 100 km

Engine:

Type – Mack ETAB 676 B 6-cylinder in-line water cooled high rise 4-stroke diesel.
Output – 228 kW @ 1 800 rpm
Torque – 1 585 Nm @ 1 200 rpm

Transmission:

Mack Maxi torque TRL 1078, 5-speed constant mesh – triple countershaft.

Axle Type:

Front – hypoid drive axle with differential lock.
Type – F.A.B.C.O.SDA 18
Rear – Mack SWS 571C – Double reduction tandem axles.

BGK 100M

The Tapir was developed in the late 1980s as a weapons platform for the South African Special Forces. It had a monocoque hull designed to accommodate five passengers. Only nine Tapirs were manufactured. The Tapir driveline was similar to the Mfezi using Samil 50 Mk II componants. Special Forces viewed the vehicle too big and heavy for operations. The Tapirs were eventually withdrawn from service and have since been used in Afghanistan and Somalia to great effect in humanitarian mine-clearing operations. The Tapir has been fitted with steel wheels to clear paths by driving through areas known to have landmines.

TAPIR

SPECIFICATIONS

Dimensions:	
Length	7 100 mm
Height (roof)	3 030 mm
Width	2 460 mm
Wheel base	3 910 mm
Mass:	
Tare	12 000 kg
GVM	14 000 kg
Performance:	
Top speed	90 km/h
Grade ability	60%
Fuel tank capacity	360 litres
Water tank capacity	370 litres

Electrical System: 24-volt system

Protection Levels:

7.62mm x51mm ball ammunition protection
2 xTM-57 landmine protection

Engine:

ADE 409N (5 cylinder), water-cooled, diesel.
138 kW at 2 200 rpm
674 Nm at 1 300 rpm

Transmission:

ASTAS S6-65 six-speed synchromesh

Transfer box:

Z-65 two-speed with differential lock.

Axles:

Front Iveco – 8 000 kg drive axle
Rear Iveco – 13 000 kg drive axle with differential lock.

Suspension:

Semi-elliptical leaf springs with telescopic shock absorbers.
Anti-roll bars front and rear.

The SA Army parachute battalions needed an airdroppable mine and ballistic-protected support vehicle to replace their ageing Ferret scout car. A prototype armoured fighting vehicle for the SA airborne forces was designed by Mechem Consultants in the mid-80s.

IRON EAGLE

It was called the *Yster Arend* in Afrikaans or Iron Eagle after the insignia of 44 Parachute Brigade. For logistics commonality and in view of the very large number of components and spares held by the SA Army at that time, one of the project requirements was that the Iron Eagle should be based around Mercedes Benz Unimog truck components. Another requirement was that three Iron Eagles should be transportable in a C-130 Hercules aircraft, which could only carry two Ferrets.

The Mechem designers came up with a lightweight, highly mobile vehicle ideal for rapid deployment. The 4x4 Iron Eagle weighed 4 tons and had a mine-protected monocoque hull. It was 3 600 mm long, 2 100 mm wide and only 1 740 mm high. Its low centre of gravity gave the vehicle good rough-terrain and side-slope mobility though this meant having to sacrifice the Unimog's traditionally high ground clearance.

Though the Iron Eagle met all the project requirements and was considered an excellent vehicle by the Parabats, it was unfortunately shelved owing to budget constraints.

The Iron Eagle prototype was later further developed by Alvis (after they bought OMC from Vickers) as the Alvis Acorn and later as the Scarab. Subsequent improvements led to a larger vehicle which was successfully test-trialled in Bosnia but never went into

production.

Armscor developed the MAN 8x8 gun tractor to replace the Samil-100 soft-skin gun tractor. A higher payload and better mobility was required to pull the G-5 gun in Angola.

MAN 8x8 GUN TRACTOR

The G-5 is a highly accurate 155 mm gun/howitzer with a maximum range of 39 km, which utterly outclassed all other artillery of the time, but for the type of war being fought by the South Africans in Angola, greater and preferably protected mobility was essential.

The G-6 would later meet this requirement, but an 8x8 gun tractor with an armoured and mine-protected cab was also developed to provide the G-5 with greater mobility and protection for the gun crew against mines and ambushes. This vehicle used MAN components and its mine-protected cab accommodated a crew of eight, although only five are required when the gun is in action. The gun tractor was able to carry 15 projectile pallets, each pallet weighing 189 kg, which were loaded and unloaded using a hydraulic crane mounted at the rear of the loadbed.

With the hostilities drawing to an end in Angola and the significant impact that the G-6 had in the closing stages of the war, there was no longer an immediate requirement for the MAN 8x8 which never went into production.

Armscor and Truckmakers developed the Sealegs in 1989 as a result of a foreign requirement for a mobile fire control post to accompany the G-6 self-propelled howitzer. The concept of this 6x6 vehicle was pioneered by Koos Joubert and Frans Beetge in the Mine-protected Vehicle Division of Armscor. Together with the G-6 gun howitzerthe Sealegs vehicle performed well in the desert trials and demonstrated exceptional mobility in ambient temperatures of up to 51°C.

SEALEGS

The 6x6 vehicle was based on the SAMIL-100 truck components and fitted with an ADE 447T engine coupled to a ZF 6WG200 transmission box.

Access for the driver and co-driver was through two side doors and a machine gun hatch. In the rear compartment was 170 litres of drinking water in a chilled pressurised reservoir, an air-conditioner, internal lighting with blackout facility, a refrigerator with ample stowage bins and working tables with four adjustable seats.

The Sealegs vehicle was used as the base design forthe Okapi 6x6 vehicles that were manufactured and used as an electronic warfare system. The Sealegs fire control post vehicle has since been converted to a mobile laboratory and is being used as a vehicle testing platform.

SPECIFICATIONS

Dimensions:	
Length	7112mm
Width	2 489 mm
Height	3 022 mm
Ground clearance	482 mm

Mass:	
Tare	17 236 kg
GVM	17 690 kg

Turning circle:	
Curb to curb	22.81 m

Protection level:

Ballistic – 7.62 mm

Blast – 2 xTM-57 landmine anywhere under the hull, 3 xTM-57 under any wheel.

Engine:

Type – ADE 447T 6-cylinders in vertical configuration.

Maximum power – 213 kW @ 2 100 rpm
Maximum torque – 1 265 Nm @ 1 100 – 1 500 rpm

Transmission:

Remote mounted ZF WG 200 power-shift transmission with hydrodynamic torque converter.

Automatically operated lock-up clutch facility.

Steering system:

Front and middle axles were steerable. Steering box was power assisted ball and nut type which was hydraulically assisted by an engine driven hydraulic pump. An additional hydraulic doubleacting ram also controlled by the steering box was fitted between the hull and intermediate Pitman arm to assist in steering.

Suspension:

Semi-elliptical leaf spring packs, mounted in spring eyes and shackles were fitted longitudinally between all three axles and the underside of the monocoque hull.

Hydraulic, double acting, telescopic shock absorbers and rubber bump stops were fitted to the front and middle axles. All three axles were stabilised by torsion bars.

Brakes:

Service brakes – operated front, middle and rear brakes.

Parking brake – operated rear brakes by venting the spring energised brake chambers.

Engine exhaust brake – pneumatically operated on the engine exhaust manifold by a foot control valve.

Electrical system:

System voltage – 24-volt

Three phase alternator-28-volt, 120-volt

Starter motor – 24-volt, 4.8 kW

Two batteries, each – 1 2-volt, 118 Ah

BISON

The Bison was developed as a weapons carrier and had a similar drive train and suspension layout to the Sealegs vehicle. The side flaps of the rear cargo area could fold out horizontally to create a larger walking area for the crew to operate various weapon systems. Access was gained by four side doors. The Bison 6x6 had enough payload capacity to carry ammunition for prolonged engagments. This prototype never went into production.

SPECIFICATIONS

Crew:	2 + 3

Dimensions:	
Length	7 117 mm
Width	2 600 mm
Height	3 030 mm
Ground clearance	477 mm

Mass:	
Tare	17 200 kg
GVM	21 000 kg
Maximum payload allowance	3 800 kg

Protection level:

Ballistic – 7.62 mm.

Landmine – 2 x TM-57 landmine anywhere under the hull, 3 x TM-57 under any wheel.

Engine:

Type – ADE 447T 6-cylinders in vertical configuration.

Maximum power – 213 kW @ 2 100 rpm.
Maximum torque – 1 270 Nm @ 1 100 – 1 500 rpm.

Range:

On road	800 km @ 80 km/h
Off road	220 km @ 25 km/h

Turning Circle:

curb to curb	23 350 mm

Transmission:

Remote mounted ZF WG 200 power-shift transmission with hydrodynamic torque converter.

Automatically operated lock-up clutch facility.

Steering system:

Front and middle axles were steerable. Steering box was power assisted ball and nut type.

Suspension:

Semi-elliptical leaf spring packs, mounted in spring eyes and shackles were fitted longitudinally between all three axles and the underside of the moncoque hull.

Hydraulic, double acting, telescopic shock absorbers and rubber bump stops were fitted to the front and middle axles. All three axles were stabilised by torsion bars.

Brakes:

Service brakes – stop master (wedge type) dual circuit air brakes with automatic adjustment.

Parking brake – spring driven, acting or rear axle.

Engine exhaust brake – butterfly valve activated by foot operated brake valve.

Electrical system:

System voltage	24-volt
Three phase alternator	28-volt, 120-volt
Starter motor	24-volt, 4.8 kW
Two batteries, each	12-volt, 118 Ah

This APC was developed by Armscorfora potential client in North Africa. Orders were not forthcoming and it never went into production. This vehicle, which had larger tyres than the Buffel, had outstanding mobility and performance characteristics. The drawback of this concept was the fact that the mine- and armour-protected capsule was mounted on top of the chassis rails.

IVECO 30

The cost per-mine-detonation was much higher than a monoque hull design like the Cass pi r.

It had seating for ten troops facing inwards, driver and co driver. Troops gained access through two rear double doors. The troop compartment had five bulletproof windows down both sides of the V-shaped hull with firing ports below them. Each rear door had a bulletproof window and firing port. There was a single door for the co-driver on this left-hand-drive vehicle. The chassis was that of an Iveco which was slightly bigger than that of the SAMIL-20.

R 38966

When the SADF's role became one of urban security operations patrolling the townships, their main vehicle was the Buffel. To improve on the safety of the troops, Buffels were refurbished and converted to a Moffel with a fully enclosed troop compartment, preventing petrol bombs being thrown into the vehicle.

BUFFEL (Moffel)

All-round visibility for the troops vastly improved with bulletproof windows along both sides, the rear and front right of the driver. The driver gained entry from a side door into the driver's cab. The driver's cab was enclosed, though there was a hatch above the cab. Troops gained entrance through a rear door. There was seating for eight troops facing inwards. A rectangular mesh-covered opening behind the driver into the troop compartment allowed improved communication between the driver and crew commander, compared to the original Buffel design. Along the top of the troop compartment were three hatches on both sides. At the front of the compartment was a hatch for a twin-machine gun mount. Each side window had two firing port holes in the bulletproof glass and one each for the front and back windows. Troop equipment storage compartments were mounted outside on the front right alongside the driver's compartment. The spare tyre was moved to the underside left of the Moffel.

The Moffel version was not produced in high numbers as the Mamba was soon to enter service in 1995.

BKP 184M

The Mfezi was designed in the late-1980s as the successor to the highly successful Rinkhals mine-protected ambulance. Apart from the body design, the main difference between the two vehicles was the use of SAMIL Mk II components and a water-cooled ADE 409N engine. Truckmakers manufactured 145 Mfezi ambulances and 18 Medical Command Post vehicles. While the Mfezi entered service with the SAMS in 1990, the vehicle was tested operationally in southern Angola during the closing stages of the Border War.

Mine-protected Ambulance
MFEZI

The name *Mfezi* is the Zulu word for a spitting cobra. The snake is the emblem of the SAMS Operational Medical Orderly, more usually known as the Ops Medic, who operates and uses these vehicles.

The Mfezi is operated by two medical orderlies and has the capacity to hold four stretcher patients who are lying down and four walking wounded. The configuration of the inside of the vehicle can be changed as needed according to the situation, such as a command and control vehicle, although this does require a workshop intervention. No major external changes are known to have been made to the Mfezi.

Similar to its predecessor, the Rhinkals has the ability to continue despite battle damage and ease of repair after anti-tank mine blasts – largely because of its V-shaped monocoque, chassis-less hull. Having been in service with the South African military for over two decades, the lifespan of these superb mine-protected ambulances was regrettably coming to an end.

The Mfezi has been deployed throughout Africa in support of the SANDF peacekeeping missions.

Mfezi Troop Carrier

This variation on the Mfezi ambulance was modified to include two additional bulletproof windows on the hull and could accommodate 12 troops facing inwards. The troops entered by electro-mechanically assisted double rear doors while the driver and co-driver had their own doors. There were inside stowage bins for personal kit and rifles with a 170 litre fresh water tank. It had a mounted LMG above the codriver. The specifications were the same as the ambulance. The Mfezi Troop Carrier never went into production.

SPECIFICATIONS

Dimensions:	
Length	6 560 mm
Width	2 480 mm
Height	3 030 mm
Wheel base	3 910mm
Ground clearance	350 mm
Mass:	
Tare	12 100 kg
GVM	13 200 kg
Performance:	

Top speed	90 km/h
Grade ability	60%
Range	on road, 1 000 km
Off road	300 km
Turning circle	19m

Engine:

ADE449T-9.51 litre 5-cylinder diesel-184 kW@2100 rpm

Transmission:

ZF S6-90 synchromesh, six forward, one reverse.

Transfer Box: 2-speed pneumatic

Suspension:

Semi-elliptical leaf springs with doubleacting telescopic shock absorbers.

The LorrieZonder Naam (LZN) was developed based on a requirement from a client in the Middle East for a vehicle to support the G-6. It had to have the same drive chain, logistical compatibility and mobility as the G-6.

Heavy Duty Off-road Transporter

LZN

The Armscor project team designed the LZN, which had a permanent 6x6 drive, around the G-6 chassis with an armoured and landmine-protected cab for its crew of five occupants. After extensive field trials, the LZN was finally shipped off to the Middle East client where it spent seven weeks doing various demonstrations. Unfortunately the client declined the LZN which was returned to the country and this prototype was not taken further. LZN stands for, *LorrieZonder Naam*, Afrikaans for lorry without a name.

SPECIFICATIONS

Dimensions:	
Length	11 900 mm
Width	3 400 mm
Height	3 370 mm
Track width	2 800 mm
Ground clearance	480 mm
Angle of approach	35°
Angle of departure	35°

Mass:	
Empty	29 tons
Loaded	55 tons
Payload	26 tons

Performance:	
Top speed	80 km/h
Maximum grade	50%
Mobility in soft sand	30 km/h
Maximum side slope	20%
Turning circle:	road, wall to wall, 28 m curb to curb, 25 m sand, 36 m
Fuel tank capacity	1 000 litres
Range on road	1 000 km

Engine:

Air-cooled-diesel with 386 kW output at 2 300 rpm.

Transmission:

Automatic with torque converter. One reverse, six forward gears.

Driveline:

Conventional prop shafts and differentials.

Permanent 6x6 mode.

Longitudinal and traverse differentials locks.

Brakes:

Drums with hydro-pneumatic brakes at front and pneumatic brakes at rear. Also equipped with a park brake, transmission and exhaust brake.

Steering:

Mechanical steering on two front wheels with full power assistance.

Hydraulic crane:

18ton, maximum winch capacity, 2 tons.

UN
UN
UN
UN
UN 52361
UN 52344
UN 52341

Chapter

1990s, INTERNATIONAL MARKETS OPEN TO SOUTH AFRICAN MINE-PROTECTED VEHICLES 5

The end of South African involvement in Namibia (former SWA) and in the Angolan conflict after 1989 and the political change in South Africa, coincided with a flare-up of conflicts in several parts of the world, most of them involving irregular forces. With South Africa now more politically acceptable, countries that would previously not have done so became interested in South African defence equipment. With mines and improvised explosive devices a growing and increasingly lethal threat, the South African mine-protected and mine-detection vehicles drew particular interest, and exports soon followed.

Ironically, the first new customer was the United Nations for its peacekeeping force in Angola, and later for use in Bosnia, Georgia and Lebanon. The Buffel was soon in service with the forces of five countries, the Casspir and Mamba each in 18 countries, the mine detection Husky in eight countries, and the RG12 riot control vehicle in 14 countries. Quite a turnaround for vehicles developed in the face of a UN-led arms embargo. These vehicles have given rise to an entire generation of further-improved mine-protected vehicles, developed in South Africa and in other countries.

A requirement for a ballistic- and landmine-protected vehicle to be used for border protection and counterinsurgency operations within the borders of South Africa was identified during 1987. Mechem Consultants submitted a proposal to the SA Army during September 1988 for the evaluation of two prototype Mamba vehicles based on Toyota Dyna 4 ton truck components. The idea of a Toyota driveline was to ensure that Toyota dealers around the country could support the vehicle. The SA Army purchased a number of the 4x2 Mamba Mk Is during the early nineties.

MAMBA Mk I

The 4x2 version lacked mobility on certain routes along the border where it was mountainous, resulting in them being gradually withdrawn from military service in favour of a more practical Mamba Mk II 4x4 based on Unimog parts.

The V-shaped armoured hull of the Mamba Mk I had protection against small-arms fire and shell fragments. With a driver and co-driver, the vehicle could carry eight fully equipped troops seated in the rear cabin. There were six roof hatches above the rear compartment and external stowage bins along the side.

The basic configuration of the vehicle was standard, with the driving compartment at the front behind the engine.

SPECIFICATIONS

Crew:	2 + 8
Dimensions:	
Length	5 883 mm
Width	2 363 mm
Height	2 468 mm
Wheel base	3 412 mm
Ground clearance	343 mm
Mass:	
Empty	4 950 kg
Loaded	6 450 kg
Performance:	
Top speed	120 km/h
Grade ability	28.6°
Trench crossing	48°
Angle of approach	48°
Angle of departure	43°

Protection level:

Armour – protected up to 7.62 mm ball NATO.

Engine:	
Type	in-line diesel
Horse power	139 @ 2 900 rpm
Model	JO 5 C
Manufacture	Toyota
Number of cylinders	4

Transmission:

Type – manual, 6-speed synchromesh, five forward and one reverse gear.
Model – H261
Manufacture – Toyota

YBP 001

The Mamba Mk II was for the most part similar to the Mk I, except that it used a Unimog 416-162 (same as Buffel) powertrain and suspension and a landmine-protected hull. The Mamba MkII 4x4 entered service with the SA Army in 1994. It had a V-shaped all-steel welded hull and was developed and manufactured, at various stages, by Mechem, TFM and Sandock-Austral. The landmine-protection requirement of the vehicle was that the occupants would survive the detonation of a single TM-57 landmine below the hull, or two TM-57 landmines below any wheels.

MAMBA Mk II

With a driver and co-driver, the Mamba is able to carry nine fully equipped troops seated facing inwards, four on the left and five on the right. All occupants enter the Mamba through a rear door.

A spare wheel is mounted externally on both sides in the centre of the vehicle. Standard equipment includes a 100 litre fresh water tank for the occupants.

SPECIFICATIONS

Crew:	2 + 9
Dimensions:	
Length	5 460 mm
Width	2 205 mm
Height	2 495 mm
Wheel base	2 900 mm
Ground clearance	410 mm
Mass:	
Empty	5 710 kg
Loaded	6 800 kg
Performance:	
Top speed	102 km/h
Range	900 km
Turning circle	12.5 m
Protection levels:	
Ballistic – 7.65x51 mm	
Blast-1 xTM-57 landmine underthe	
hull or 2 xTM-57 mines underany wheel.	
Engine:	
Make	Mercedes Benz
Type	in-line diesel
Horse Power	123 @ 2 800 rpm
Model	OM 352
Number of cylinders	6
Transmission:	
Make – Mercedes Benz	
Type – manual, 4-speed synchromesh, four forward gears and one reverse.	

Model – UG 2/30

Suspension System:

Type – coil spring

UN
UN

In 2006, about 220 of the Mk IIs in the SA Army were upgraded to Mk IIIs, under Project Jury. The Mk III upgrades included improved stability, better braking capability and improved ballistic protection. The Mk III Mamba had disc brakes while the Mk II had drum brakes. Following South Africa's re re-admittance to the international community in 1994, the Mamba Mk II was in demand, being purchased by a significant number of countries.

MAMBA Mk III

The UN was the lead customer, acquiring the vehicle for peacekeeping operations in Angola, Bosnia, Kosovo and Sudan. More than 800 Mambas are in use by 18 countries. This image shows the Mk III on deployment with the SANDF Battalion of the Force Intervention Brigade on patrol in the Massisi area, North Kivu Province of the DRC.

SPECIFICATIONS

Crew:	2 + 9
Dimensions:	
Length	5 460 mm
Width	2 205 mm
Height	2 495 mm
Wheel base	2 900 mm
Ground clearance	410 mm
Mass:	
Tare	5 565 kg
GVM	6 500 kg
Performance:	
Speed	102 km/h
Range	650 km
Turning circle	12.5 m

Protection level:

Ballistic – up to 7.65x51 mm and 5.56x45 mm.

Blast – 1 xTM-57 landmine under the hull or2xTM-57 under any wheel.

Engine:

Make – Mercedes Benz

Type – liquid cooled, direct injection, four stroke 6-cylinder diesel.

Maximum power – 92 kW @ 2 800 rpm
Minimum torque – 348 Nm @ 1 900 rpm Model – OM 352

Transmission:

Make – Mercedes Benz

Type – manual, 8-speed synchromesh,
four forward gears and one reverse.

Suspension System:

Front – single coil spring

Rear – double coil spring

Brakes:

Dual hydraulic / air system
Disc on front and rear

Axles:

Make – Mercedes Benz
Type – rigid, incorporating portal hub reduction with pneumatically operated differential locks.

Variations were available in the Mk II and III as an ambulance and light recovery vehicle which also included a short wheel base, a weapons platform and four-man cab with a cargo area:

Komanche

Light Recovery Vehicle

Ambulance

Sabre

Scorpion

TFM developed a weapons platform for the SAP (RG31 Scorpion), similar in appearance to the Mamba but based on Rockwell axles and ADE engine and an Allison gearbox.

Mamba variants

By the late 1980s the role of the SA army had shifted with a greater emphasis on COIN operations and then again in the latter part of the 1990s to peacekeeping. The open-topped Buffel was not designed for this role, offering no protection in the urban environment where multi-storied buildings were frequently encountered. Following Mechem's development of the Mamba concept vehicle in 1988 and after extensive evaluations, the SA Army in the early 1990s announced that it would replace the Buffel with the Mamba as their new APC. The Mamba was tested in a number of areas throughout South Africa where different COIN tasks were being carried out with the user evaluation being completed in July 1993. Since then the Mamba has been manufactured by a number of companies resulting in many variants, some of which are shown below.

Mamba Mk I – Sabre 4x4 weapon platform (Mechem, 1993).

Mamba Mk I – 11-man (TFM and Sandock Austral).

Mamba Mk I – 11 -man, a TFM facelift to the RG31 with a different type drive-line.

Mamba Mk I – 11-man prototype with one long side window and roof-mounted air-conditioned unit.

Mamba Mk I – 2x4 11 -person, remanufactured OTT.

Mamba Mk I – 7-man.

Mamba Mk II – 4x4 SANDF (Reumech Sandock).

Mamba Mk II – Flatbed 4x4 (Reumech Sandock).

Mamba Mk II – 4x4, later production model (Reumech OMC).

Mamba Mk II – 4x4 used by the UN during the Bosnian conflict (Reumech OMC).

Mamba Mk II – 4x4, SA Air Force (Reumech OMC).

Mamba Mk III.

Mamba Mk III.

SPECIFICATIONS

Dimensions:	
Length	5 200 mm
Width	2 500 mm
Height	2 700 mm
wheel base	3 000 mm
Ground clearance	322 mm
Angle of approach (without scraper)	30°
Angle of departure	41°

Mass:	
Tare	7 820 kg
Payload	1 580 kg
GVM	9 400 kg

Performance:	
Top speed	100 km/h
Turning circle, curb to curb	13.5 m

Engine;

Make – Mercedes Benz, OM 366A
Type – liquid cooled, direct injection 4-stroke, 6-cylinder diesel.
Maximum power – 125 kW @ 2 800 rpm
Maximum torque – 560 Nm @ 1 500 rpm

Transmission:

Allison, AT-545, 4-speed automatic.

Transfer box;

Rockwell, BT 232, 2-speed permanent with 4-wheel drive selection.

Suspension:

Springs – semi-elliptic leaf
Shock absorbers – double acting, telescopic, hydraulic.

RG12 NYALA

Production of the RG12 Nyala armoured personnel carrier was started in 1990 by TFM's Defence and Security Division. Developed as a riot control and urban patrol vehicle, this vehicle forms the backbone of the SAPS public order policing elements. The RG12 has a welded all-steel armoured monocoque hull. Five doors provide ease of access with the main side doors, which are pneumatically operated, that slide open, remaining close to the hull thus facilitating ease of deployment for occupants when the vehicle is near to a building or wall.

The RG12 seats ten troops back to back facing outwards with a driver.

A unique aspect of the RG12 is that the power unit, coolant system, transmission and air inlet system are all mounted on a sliding rail with coupling hooks which can be removed and replaced within 30 minutes.

It is protected against 5.56x45 mm NATO ball while the underside is protected against

firebombs, M26 hand grenades and anti-personnel mines.

More than 900 of these vehicles are in service within some 14 countries. The Italian Carabinieri was a major export customer.

The Caddie armoured personnel carrier was developed by Armscor and TFM in 1992 as a private venture. It was based on a Mercedes Benz Unimog 416 (4x4) chassis, fitted with an armoured body that provided the crew with protection from small-arms fire, shrapnel and anti-personnel mines. The Unimog 416 chassis had excellent cross-country mobility owing to its portal axles and four-wheel drive with differential locks that could be engaged and disengaged in motion. As the Unimog 416 was a standard commercial chassis, spare parts were available globally. The fully protected engine compartment was at the front of the Caddie, with the commander and driver seated to the immediate rear. They each had a forward-opening side door with a bu l letproof wi n d ow.

CADDIE

The troop compartment was at the rear with four men down either side on individual seats, facing inwards. On either side of the troop compartment were three large bulletproof windows and two firing ports. Normal means of entry and exit was via two doors in the rear, each with a firing port.

Mounted on the roof of the Caddie, towards the rear, was the air-conditioning system and in the front above the passenger the spare wheel.

There was a prototype ambulance variant of the Caddie capable of transporting four seated and two lying down patients.

By mid-1997 the RGI 9 Caddie, as it was later referred to, had not entered production.

In mid-1997, the TFM Defence and Security Division was taken over by Reumech OMC with the former’s range of products being integrated into the new company and the RGI 9 was not developed any further.

SPECIFICATIONS

Dimensions:	
Length	4 923 mm
Width	2 202 mm
Height up to roof	2 434 mm
Wheel base	2 900 mm
Ground clearance	400 mm
Mass:	
Unladen	5 680 kg
Payload	800 kg
GVM	6 480 kg

Designed in the early nineties, the Scout 2 was a new generation of the proven RG32 Scout armoured patrol vehicle, which was developed by TFM. The Scout 2's deliberate benign appearance made it suitable for peacekeeping, police and security operations. Good ground clearance and selectable 4x4 drive enabled the Scout 2 to operate effectively either off or on road.

Mine Hardened Armoured Utility Vehicle

SCOUT 2

The Scout 2's compact and low-mass superstructure allowed it to be operated by drivers holding a standard motor vehicle licence. The Scout 2 consisted of two main versions, the 5-seater Mine Hardened Patrol Vehicle and a 7-seater Estate with common drive train and controls.

The Scout 2 was fitted with a Detroit Diesel V. M. Motori 6-cylinder water-cooled, turbocharged diesel engine which was linked to an automatic transmission. The Scout 2 had a simple, functional cab layout and instrumentation. Crew protection in the hull consisted of an all-steel welded armoured monocoque capsule to which chassis and sub-frames were bolted.

The UN procured the Scout 2 for use in Bosnia and in other peacekeeping operations around the world.

Despite the production of the Scout 2 coming to an end in mid-1997, when TFM Defence and Security Division was taken over by the Reunert Group, a few years later the popular RG32 M emerged which was based on the concept of the Scout 2.

Seeing a potential opportunity for a luxury armoured 4x4 double cab in the civilian market, Reumech developed the A-Wagon. While the A-Wagon looked completely different to what one would expect from a security vehicle with its civilian appearance that made it seem innocuous and neutral, it was a very impressive armoured vehicle that could reach a top speed of 145 km/h.

Reumech A-Wagon

The A-Wagon was a four-door twin cab with a load bay and removable fibreglass canopy. A tubular frame with bonded and bolted armour steel panels was fitted to the chassis with anti-vibration mountings. It had adjustable seats for the driver and co-driver and a bench-type rear seat for three occupants. A useful feature was the shift-on-the-fly all-wheel drive which could be engaged at speeds of up to 120 km/h. The petrol V8 version gave the vehicle a favourable power-to-weight ratio of 29.6 kW per ton, while the diesel straight six gave a similar ratio of 30.2 kW per ton.

While the A-wagon weighed 3.5 tons, its 326 mm ventilated disc brakes brought it to a standstill from 100 km/h in 3.9 seconds.

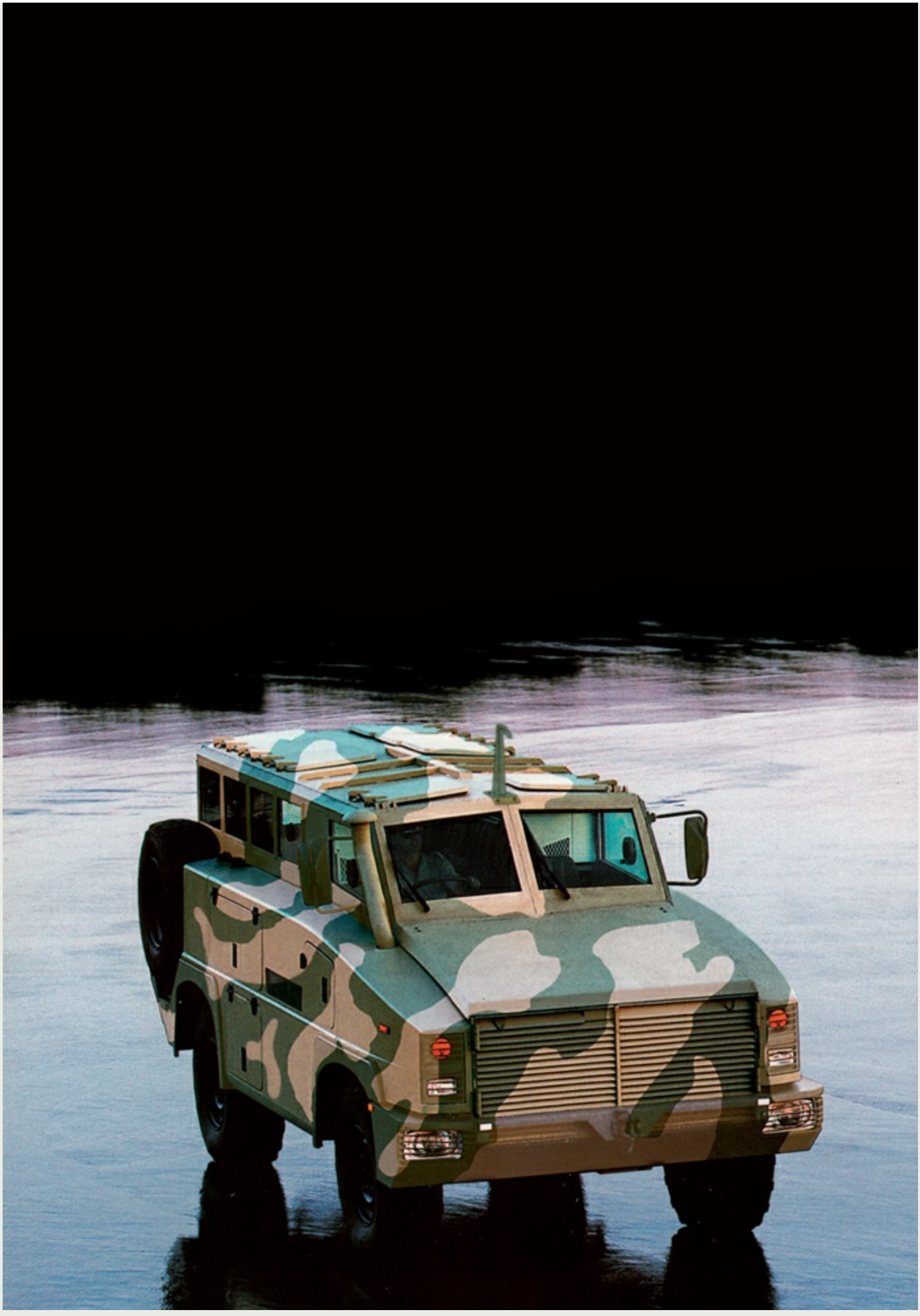
It had bulletproof windows with an armour-plated cabin providing protection against 5.56x45 and 7.62x51 NATO ball, with the underside being able to withstand attacks from antipersonal mines and a double M16 hand grenade.

Despite being a very capable vehicle, very few A-Wagons were sold.

SPECIFICATIONS

Dimensions:	
Length	5 220 mm
Height	2010mm
Width	2 075 mm
Ground clearance	240 mm
Turning circle, curb to curb	13.8 m
Wheel base	3 100 mm
Approach and departure angles	34°

Mass:	
Tare	4 100 kg
Payload	700 kg



The Kobra was originally designed and built by Reumech OMC, based on experience gained in the design, development and production of the Mamba Mk 2 (4x4) armoured personnel carrier. The company had also designed a similar-looking vehicle called the Taipan as their tender submission to meet the requirements of the Australian Army's Bushranger armoured vehicle project. Following extensive trials between the Taipan and the Australian ADI Bushmaster, the latter was selected early in 1999.

KOBRA

The Kobra was based on the Mercedes Benz Unimog U2150 4x4 cross-country chassis fitted with an all-welded monocoque steel body that provided the occupants with protection from 5.56 and 7.62 mm ball NATO small-arms fire and shell splinters.

The standard Kobra provided protection against a 14 kg TNT detonation under any wheel or under the belly of the vehicle.

In its basic APC configuration, the Kobra had a driver and co-driver and carried nine passengers. The troops sat facing inwards and entered the vehicle via a rear door. The troop compartment was fitted with large bulletproof windows.

Standard equipment included a SME 11 environmental control system with a total of six vents. There were three external stowage bins on either side of the vehicle, with a 270 litre drinking water tank•Two spare tyres were carried, one on either side of the rear of the vehicle.

The project was shelved in 2004 when no orders were forthcoming.

Armscor Senior Programme Manager, Koos Joubert, drives over an anti-tank mine in a Casspir as a live demonstration at an international defence exhibition to showcase the survivability ofpersonel travelling in this world class vehicle. This is Koos's story…

I survived the ride

South Africa participated in the International Defence Exhibition (IDEX) in 1995 in Abu Dhabi, United Arab Emirates. Koos Joubert from Armscor co-ordinated all the South African demonstrations which took place at the IDEX Military Demonstration Range in the desert some distance from Abu Dhabi. These included the famous G-6 gun howitzer, valkiri rocket launcher, Rooikat, Casspir and many smaller weapon systems.

One of the highlights of these demonstrations was the live demonstration of a Casspir APC vehicle driving over a South African No 8 A/T mine (8 kg) to demonstrate the safety and survivability of this amazing vehicle in front of an international audience.

Koos Joubert convinced his superiors that he was prepared to do this demonstration (four days in a row) as he had full confidence that it would not be a risk. He has an enormous amount of experience in the design and development of mine-protected vehicles with lots of operational experience. This demonstration would showcase to the international community that South Africa produced world-class military products.

The script was written for the demonstration's co-ordinator to read and the scene was set up some 300 metres from the main pavilion where the VIP visitors were positioned.

The mine was laid 100 mm below the ground surface in the spoor of the Casspir vehicle and the No 8 A/T mine was armed. Koos Joubert put on his blue overall and helmet and got behind the steering wheel of the Casspir where he strapped himself firmly in with the safety harness. His colleague Leon Cornelius got into the passenger seat. No ear plugs were worn as he had to listen to the countdown on the radio from the demonstration's co-ordinator.

Koos (red shin) enjoying lunch with Armscor colleague, Leon Cornelius (white hat) and his TFM contractors after their first demonstration.

Koos drove off in a forward direction and the rear wheel detonated the A/T mine. The rear end of the vehicle accelerated upwards and the front bumper nearly touched the ground as it tilted forwards. A lot of dust entered the vehicle through all possible passages and some hot gases with flames/fumes from the explosive forces of the mine entered through the transfer case and prop shaft openings which heated up the left side of Koos's leg. While in the air the clutch was disengaged by Koos and the vehicle dropped back into the crater which was 1 metre deep and 3 metres in diametre.

The running engine was switched off and Koos got out of the Casspir and waved to the demonstration co-ordinator and the spectators to indicate that he was safe.

A recovery exercise was demonstrated and a new rear axle was fitted to the Casspir within 24 minutes whereafter Koos drove past the VIP pavilion to show the spectators that he was safe and the vehicle was fully repaired and ready for operational use again.

This demonstration was repeated during the next three days and a live relay was done to the exhibition centre in Abu Dhabi for trade visitors to watch.

The then Minister of Defence Mr Joe Modisi, congratulated the South African team during the South Africa exhibitors function for performing such brave and outstanding demonstrations at IDEX 1995. Convincing demonstrations such as these led to contracts benefitting the South African defence industries.

Replacing the rear axle with a UAE military officer observing to verify the authenticy of the replacement work.

In 1996 Mecherm, with some Army funding, developed an armoured personnel carrier demonstrator, nicknamed the Krokodil, using mechanical components from the Ratel to enhance technical commonality and reduce the cost. The Krokodil was built as a very low silhouette six-wheeled vehicle with a 2+1 axle layout – partly addressing the Ratel's ditch crossing weakness – and steering on the two front axles, and using larger 16.00xR20 wheels further to improve off-road mobility, albeit using leaf rather than coil springs to be more cost effective. The powerpack was placed on the right behind the driver and co-driver, to allow two rear doors for quick mounting and dismounting. *Krokodil* is the Afrikaans word for crocodile.

KROKODIL

The driver and co-driver had a good field of view but were isolated from the rear compartment, with a very narrow escape tunnel alongside the powerpack. Intended as an APC, the Krokodil was designed for an overhead weapons station that would not take up room inside the troop compartment. That however was very cramped as a result of efforts to keep the vehicle low but with good ground clearance, with only 1.2 m from floor to roof, and access was hampered by a door only 1.1 m high.

Mechem also introduced an add-on "mine kit" to protect against self-forming fragment mines like the TMRP-6. This weighed approximately 350 kg and was fitted below the axles, severely hampering off road mobility.

Very cramped and with many automotive design shortcomings, this prototype was not

formally evaluated and the project was terminated. The Krokodil is now part of the SA Armour Museum collection in Bloemfontein.

In the mid-1990s, Mechem developed the Libhubesi for a client in Africa to be used for hunting expeditions on his private reserve amidst concerns about the possibility of landmines. *Libhubesi* is the Swazi word for leopard. Mechem at that time was involved in a joint development agreement with the Technical Solutions Group, Inc (TSG), in the USA which had been founded in 1997 by Garth Barrett, a former Rhodesian military officer, who had worked with Mechem. After completing the Libhubesi it was decided that should this size of vehicle be developed for the USA market it would be called the Lion. The first Mechem developed prototype for TSG was based on a GMC commercial truck and called Lion I, while for the Humanitarian Demining Research Department at Fort Belvoir in the USA the Lion II was built.

LION

Through TSG initially, which later became Force Protection Inc (FPI), the Lion I became the fore runner for a number of vehicles such as a special Lion I for a Darpa Project to carry specialized mine detection systems, the Cougar for the Yuma proving ground in the USA and the Tempest for the UK. For the Mechem developed Lion II, the protected cab area was lengthened and all the additional equipment added for the Army Route Clearance System which was tested under the Foreign Competitive Test programme. That model became known as the Buffalo and was used extensively by the US military in Iraqi and

Afghanistan.

During this development phase a number of South African design engineers were employed by TSG which was purchased by Sonic Jet Inc. in 2002 and shortly thereafter evolved into Force Protection Inc.

Dr Vernon Joynt joined FPI in late 2003 and made his scientific contribution to the vehicle programmes from then onwards.

GMC

F60 FRFS

In the mid-1980s the SADF was in the market for heavy-duty recovery vehicles, initially for the Olifant tanks and later also for the G-6. Having looked at a number of options, they finally settled for a Spanish company, Kynos, that in 1982 built the Aljaba 8x8 that was used by the Spanish armed forces as one of Spain's primary tank transporters. These 8x8 vehicles are used as modified heavy-duty recovery and maintenance and repair vehicles known in the SANDF as the Cavallo, Skimmell and Zebra. The Thutlwa air-defence radar also uses this truck as its platform, as well as the ground-launched version of the Umkhonto surface-to-air missile system. These South African-modified vehicles were developed as a family of technical vehicles that have been upgraded with armoured and landmine-protected cabs. The project name for Aljaba was Project Raadsaal.

KYNOS ALJABA

The chassis and suspension of the Kynos Aljaba 8x8 were built for off-road use, making them very useful for the SA Army. The forward-mounted cab is positioned rather low since the engine is mounted between the front wheels. The chassis is built on a reinforced flexible frame, and the 8x8 suspension has swing arms for the front and rear axle sets. The transmission is semi-automatic, and the driver has power-assisted steering, with the two front axles being steerable and the steering being power-assisted. Each pair of axles may be pneumatically locked. The Kynos Alijaba has air brakes as well as external tyre inflation systems. The 8x8 chassis has large tyres that perform well in sand and the bushveldt. A spare wheel with a handling crane is provided, and mounted behind the cab. Behind the cab is a pair of 25-ton-capacity winches with 26 mm-thick cable.

The South African Cavallo 8x8 version is an extra heavy recovery vehicle in the 35 000 kg – 60 000 kg mass category with an armoured and landmine-protected cab. The Cavallo also has a foldable A-frame crane used in concert with the winches; it may be used only when a semi-trailer is not attached to the Cavallo, as it gets in the way of the fifth wheel. The Cavallo has also been modified to tow a 60 ton semi-trailer allowing it to transport vehicles in off-road conditions.

Skimmel 8x8

The Skimmel 8x8 Heavy Recovery Vehicle is a high mobility recovery system, designed to recover vehicle casualties, the Olifant tank and G-6 wheeled artillery system, from forward combat areas to field repair facilities. The Skimmel is based on the Cavallo chassis and has an armoured mine-protected cab. Unlike the Cavallo, it is not fitted with a fifth wheel, though additional recovery equipment is fitted. The Skimmel has a 12 ton tow arm, 20 ton winch, 7.6 ton crane with a 4 metre reach and various other equipment.

Zebra 8x8

The Zebra 8x8 maintenance and repair vehicle is a specially designed high-mobility vehicle, built and equipped to assist in maintenance and repair on front lines of combat areas. The Zebra is based on the Cavallo chassis and has an armoured and mine-protected cab. The Zebra carries various tools and parts in the two containers and a 20 ton crane is fitted at the rear of the vehicle to lift the power pack of a Main Battle Tank which weighs 5 tons.

Thutlwa 8x8

Four of these systems were ordered in 1996 under Project Bioskoop and delivered by 2006. The Thutlwa is a highly mobile solid-state L-band 2D surveillance radar system designed to provide early warning to air-defence artillery troops in the field. It is a fully autonomous armoured and landmine-protected system with a self-contained power plant packaged on the Kynos Aljaba 8x8, and is capable of being fully operational within ten minutes of arrival at the deployment site. Coupled to the battlefield-specific local warning sensor design, the system is a pivotal element of the SA Army Ground-based Air Defence System, which is able to track up to 100 targets simultaneously to a range of 120 km. The mast is 12 metres tall. The system currently provides local warning, command and fire control to the ADA's 30 GDF 05 L90 twin 35mm towed cannon. The Thutlwa was also known previously as the Kameelperd. The RRS DBXL dual-band radar is a further development of the Thutlwa, and will also be mounted on the same vehicle type.

Umkhonto 8x8

The ground-launcher for the Umkhonto carries eight missiles in an elevating launcher unit, plus the data link to the command vehicle. The Umkhonto uses the Kynos Aljaba 8x8 truck as its platform. The entire unit can be dismounted from the vehicle. The Umkhonto is at this stage offered only in an infra-red homing version with mid-course guidance provided by a dualbank radar. It has demonstrated a range of 20 km and has also demonstrated remarkable accuracy, with telemetry rounds having scored'kinetic kills' – otherwise known as flying through the target – against Skua (in South Africa) and Banshee (in Finland) targets. Denel Dynamics is developing longer-range and radar-guided versions.

MAN Bridge Layer

The MAN 8x8 chassis has been used as the basis for a bridge-layer vehicle. Ten bridge-laying vehicles and ten bridge-carrying vehicles were built, with twenty bridges constructed

of aluminium also being delivered to the SANDF. The bridge layer uses a modified MAN 8x8 chassis with the landmine-protected cab mounted lower since the LEGUAN 22 metre MLC 70 ton part bridge extends over the cab. A large bridge-launching arm is installed at the rear of the chassis. When launching the bridge the two parts are moved horizontally into position. Then the launch arm extends towards the rear and two jacks are lowered. Finally the bridge is placed over the span that is to be crossed. Laying and lifting a bridge takes five to ten mintues.

Chapter 6

DEMAND FOR SOUTH AFRICAN MRAPs IN IRAQ AND AFGHANISTAN

South African vehicle protection technology really became visible on the international stage when the wars in Iraq and Afghanistan developed into long-drawn-out insurgencies, with mines and improvised explosive devices (IEDs) quickly becoming the greatest threat to coalition forces in both theatres. While the initial South African vehicles had been focused on protecting their crews and passengers against anti-tank mines, they were soon further developed to protect against roadside IEDs and even car bombs – the crew of one RG31 surviving a car bomb that detonated right next to it – and added weapons mountings and turrets to fight off ambushes. In American use these vehicles were termed mine-resistant and ambush-protected (MRAP) vehicles, becoming an entirely new class of armoured vehicle.

BAE Land Systems' RG31 quickly developed into a much more heavily protected beast that proved its ability to protect its crew against the massive IEDs encountered in Iraq, and then spawned the RG35 family, while other South African companies developed their own vehicles with additional emphasis on protection against blasts to the side of the vehicle and not just under it. In addition, Land Mobility Technologies developed mine- and IED-protected armoured cabs and a similarly protected personnel carrier module that can be picked up by any 10 ton or larger hook-lift truck, and which can also be fitted as a medical evacuation module or command post. The DCD's mine-detection Husky meanwhile evolved into a system also capable of detecting certain IEDs and jamming radio-detonated IEDs.

The name RG31 is a little confusing at first as there were two vehicles designated as such. The first was the RG31 Nyala, developed by TFM on the basis of the 4x2 Mamba which was upgraded to 4x4 drive with upgraded protection levels and some other modifications, and then marketed internationally. The Canadians were the lead customer, for use in Bosnia and Afghanistan, referring to this vehicle as the RG31 Nyala Armoured Patrol Vehicle.

RG31

The second RG31, as featured on this page, is the one built by BAE Land Systems South Africa. Although based on the TFM RG31 Nyala after TFM was acquired by BAE, it was redesigned to be larger and heavier. This is the RG31 that spawned a family of versatile utility vehicles able to fulfil many roles in areas requiring high levels of crew protection, which became a popular MRAP with the coalition forces operating in Iraq and Afghanistan.

The monocoque V-shaped hull is of all-welded steel that provides the occupants with protection against 5.56x45 mm and 7.62x51 mm fire. Landmine protection is provided against one TM-57 anti-tank mine under the body and two TM-57 anti-tank mines under any wheel.

The engine compartment is at the front. The driver and commander both have armoured steel side doors with bulletproof glass windows to their front and sides. The personnel compartment is at the rear, with entry via a pneumatically assisted door. Large bulletproof windows are provided in the sides and rear. Early RG31s had eight hatches in the roof, which could be locked in the vertical position to provide some protection when operating ‘heads out’. Subsequent variants had only two roof hatches, the front one being generally used for a weapons mounting or a Remote Weapon Station (RWS) or small turret; weapon mounts by themselves are typically surrounded by AV2 gun shields.

In the early days of IED threats in Iraq and Afghanistan there were no vehicles known as

MRAPs. When the coalition forces realised the shortcomings of their soft-skinned military vehicles, the only proven light mine-protected vehicle on the market was the RG31. Having been successfully deployed with peacekeeping forces in Bosnia and Lebanon, it immediately attracted the attention of the military looking to protect their soldiers from the rapidly rising IED casualty rate. Without doubt, the RG31 was the world's best mine-protected vehicle in its class, with its capability endorsed by none other than the US armed forces, who despite their notorious reluctance to 'buy foreign', became a major user of this vehicle, initially referring to it as the RG31 Charger.

After successful trials of ten vehicles in 2003 and 2004, the RG31 was deployed with the US Army, Task Force Pathfinder in Iraq (82 Airborne Division) and with units in Afghanistan including USMC EOD teams. In February 2005 the US Army purchased an additional 148 vehicles and in August 2007, US Forces ordered another batch of 492 RG31 vehicles, including 309 of the improved RG31 MkV variant for the US Army and Special Operations Command (SOCOM). According to the manufacturer, the RG31 has been used, in various versions, by the forces of Canada, Colombia, France, the Netherlands, Rwanda, Spain, the United Arab Emirates, the US Special Operations Command, US Army, the US Marine Corps and the United Nations, with more than 3 700 in use around the world.

SPECIFICATIONS FOR RG31 M

Crew:	1 + 9
Dimensions:	
Length	5 740 mm
Width	2 220 mm
Height	2 565 mm
Wheelbase	3 400 mm
Ground clearance	325 mm
Angle of approach	40°
Angle of departure	35°
Mass:	
Tare	7 500 kg
GVM	9 000 kg
Performance:	
Top speed	120 km/h
Grade ability – low-range	60%
Turning circle, curb to curb	18 m
Engine:	
Make and model – Detroit Diesel V.M. Motori	
Maximum power (DIN) – 128 kW @ 3 200 rpm	
Maximum torque (DIN) – 460 Nm @ 2 000 rpm	
Transmission:	
Make – Allison AT 545 Type – 4-speed automatic	
Transfer Box:	

Make – Meritor
Type – BT 232

Steering System:

Type – hydraulically assisted

Suspension:

Springs – semi-elliptical leaf springs.
Shock absorbers – double acting telescopic hydraulic.

Brakes:

Service brakes – dual circuit pneumatic, drums front and rear, 4-circuit ABS.
Parking bakes – spring operated on rear drums.

Overtime the RG31 was further developed into multiple variants and, particularly, variants with much greater protection levels, the soundness of the design being proven by its ability to grow greatly in weight – and installed power – without a total redesign. While it is difficult to record all the variants, listed are a few of the main variants and marks that have been developed since 2001: RG31 Charger, US Army version of the Mk III with a Detroit diesel engine. RG31 Mk V, upgraded version of original RG31 specifically for the US Military with new armour and a Cummins engine. RG31 Mk5E, a stretched MkV with a larger passenger/cargo capacity and improved blast and ballistic protection. RG31 Mk VIE, enhanced crew protection. RG31 M, a Canadian version with special equipment installed, including jammers (to prevent roadside bombs from being detonated via a wireless device) and a remotely (from inside the vehicle) operated 12.7 mm machine gun. It had a crew of five with an enclosed cargo area.

SPECIFICATIONS FOR RG31 MK5 EHM

Crew:	1 +7
Dimensions:	
Length – (including jerry can)	7 000 mm
Width	2 500 mm
Height – (top of gun ring interface)	2 800 mm
Wheelbase	3 805 mm
Ground clearance	460 mm
Angle of approach	36°
Angle of departure	36°
Mass:	
Tare	16 000 kg
(including level 3 ballistic protection)	
Payload	2 600 kg
GVM	18 600 kg
Performance:	
Top speed	100 km/h
Grade ability – low-range	60%
high-range	25%
Turning circle, curb to curb	16.2 m
Engine:	
Make and model – Cummins QSB	
Maximum power (DIN) – 221 kW @ 2.500 rpm	
Maximum torque (DIN) – 1.100 Nm @ 1.600 rpm – 1.800 rpm	
Transmission:	
Make Allison – 3000 SP	
Type 6-speed automatic	
Transfer Box:	
Make and model BAE systems (gear ratio).	
RGR 17T	
Type 2-speed, permanent 4-wheel drive.	

Steering System:

Make ZF

Type hydraulically assisted recirculation ball.

Axles:

Make and model – Axle Tech series 4500 ISAS independent suspension.

Brakes:

Parking brake pneumatic release spring applied on rear axle.

Pneumatic, dual circuit disc brakes with ABS.

Light High-mobility
RG31 LHM

The RG31 LHM 4x4 is designed for multiple missions. It is a tactical utility vehicle with a cargo bay that can be used to transport cargo or for routine patrols. It is equipped with a medium turret. The driver and passengers gain access through four doors. This vehicle is a prototype and has currently not gone into production.

SPECIFICATIONS

Crew:	1 + 7
Dimensions:	
Length	5 450 mm
Width (without mirrors)	2 750 mm
Width (without spare wheel)	2 630 mm
Height	2 595 mm
Ground clearance	414 mm
Wheelbase	3 030 mm
Track	2 176 mm
Angle of approach (min)	53°
Angle of departure (min)	45°
Mass:	
Tare (empty)	12 200 kg
Payload	5 800 kg

Gross vehicle mass (tactical)	18 000 kg

Performance:

Range	1 000 km
Maximum speed	105 km/h
Grade ability	>60%
Turning circle, curb to curb	14 500 mm
Trench crossing	1 050 mm

Protection Levels:

Ballistic protection – up to STANAG A 4569 level 4.

Mine protection – up to STANAG B 4569 Level 4A/4B.

IED side protection level undisclosed.

Engine:

Make Cummins ISL
Max power 336 kW / 450 hp
Max torque 1 620

Letters of thanks.

We survived the ride

DEPARTMENT OF THE ARMY
BRAVO COMPANY, 367TH ENGINEER COMBAT BATTALION (CORPS) (LIGHT)
CJTF 76, BAGRAM AIR FIELD
APO AE 09354

OMC
12 Barnsley Road
Benoni, 1501
South Africa
Phone: +27(0) 11747 3300
Fax: +27(0) 11845 1398

October 13, 2004

To whom it may concern,

We are writing this letter to thank you for producing a truly great vehicle, the RG-31. If it was not for its superior design and manufacturing, we would not be able to write this letter today.

While on a vehicle patrol in southeastern Afghanistan, our vehicle suffered a possible mine strike or Improvised Explosive Device (IED) attack. All five passengers of the vehicle were able to exit the RG-31 and run to the next vehicle in the convoy, where we were treated for minor injuries and continued to carry on with the mission. The driver, the machine gunner, and myself were taken by helicopter to the closest medical station and kept overnight for observation.

After going through an ordeal like this, we feel compelled to thank the company responsible for the RG-31. We also feel that we could provide some good feedback to you in regards to what, if any, changes or additions could be made to the vehicle. We hope that the U.S. Army takes into consideration how valuable the RG-31 is compared to an "up-armored" Humvee, and is in the process of buying more of these vehicles. We had two RG-31's in Afghanistan, now we have one. The threat of mines and IED's is still prevalent. We are ready to go back out and do our job of finding these threats, we would just feel better equipped if we had more RG-31's. We urge your company to do whatever it takes to sell or market this and all your other protective vehicles to the U.S. Army. If needed, we can provide written testimony in regard to the RG-31. We thank you for your time and consideration. We look forward to corresponding with you.

Respectfully yours,

Owen Rice
Staff Sergeant
Combat Engineer Squad Leader

Marc Fickas
Specialist 4th Class
Combat Engineer, RG-31 driver

P.S. We have enclosed photos taken just moments after the attack.

From: randy perkins
Sent: 10 January 2008 22:10
Subject: Thank you

Greetings: This is a brief heart felt thank you from a father of an American soldier serving in Iraq. My son (Matthew) was injured last week when his RG31 hit a large IED. The vehicle was destroyed.
Aside from minor injuries, Matt and his crew survived in excellent condition. He thanks God and whoever made the vehicle (I think it was your company). My wife and I have four sons. You probably get a lot of these stories but I hope you understand that what you do in your jobs saves soldiers' lives and protects families. At the end of the day you have made a difference. Keep up the good work.

Thank you. Mr. Randy Perkins/Jamestown, ND/USA

Good morning,
My name is Brian Jillson, I have been in Iraq for 10 months. My job over here is route clearence. I have been driving the RG31 since we have been here. So far I have been hit by 9 IEDs in the same RG31. No injuries and the worst damage has been a flat tire and some broken windows. I wouldn't want to roll outside the wire in anything else. Thanks for a great truck.
Brian Jillson

MAX LAST 1000KG
7

Continuing with the successful RG32 light armoured family of vehicles, the RG32M 4x4 was developed as a mine-hardened light-armoured patrol vehicle. In a typical patrol mode the RG32M 4x4 can transport five crew members with their kit, combat and special purpose equipment for a 48-hour battlefield mission, with a maximum payload capacity of 1 200 kg.

RG32M

Another full-length armoured body version extending to the rear axle of the RG32M is also available, able to carry seven crew members with their kit and a maximum payload capacity of 1 000 kg. Access and egress for both is through two side doors and roof-mounted hatches.

The V-shaped all-steel, welded and monocoque hull and ballistic glass windows of the RG32M provides protection to the crew and the engine compartment against 7.62x51 mm and 5.56x45 mm NATO ball ammunition, and against the blast and fragments of DM31 fragmentation mines.

Given the variety of applications in several military and non-military roles for scouting, patrol, command, liaison and peacekeeping, the RG32M has proved very popular. Currently, more than 350 RG32s are being operated globally by Finland, Sweden and Ireland. The RG32M subassemblies are commercial-off-the-shelf (COTS) items used to construct the RG32M, making it cost-effective and reliable with good worldwide support. Two RG32Ms can be loaded into a C-130 Hercules at the same time, or three in an aircraft like the A400M or four in an Illyushin 76.

In Sweden, the RG32M was taken through various ‘winterisation’ modifications where it is known as the Galten. The vehicle has proven to be equally effective at 49°C in the African and Middle Eastern desert conditions as it is as at -35°C in the ice-cold Swedish weather.

65480
7

SPECIFICATIONS

Crew:	1 + 4
Dimensions:	
Length	5 330 mm
Width	2 175 mm
Height	2 180 mm
Wheelbase	2 900 mm
Ground clearance	430 mm
Angle of approach	53°
Angle of departure	33°
Mass:	
GVM	9 500 kg
Tare	7 500 kg
Performance:	
Top speed	110 km/h
Grade ability – low-range	60%
Turning circle, curb to curb	17 m

Range	1 126 km

Protection Levels:

Ballistic – 7.62x51 mm NATO ball,

5.56x45 mm SS109 NATO ball,

7.62x51 mm AP with appliqué armour.
Blast – DM31 fragment mine.

Engine:

Make Steyr M16TCA turbocharged intercooled.

Maximum power – 135 kW @ 3 800 rpm
Maximum torque – 406 Nm @ 1 800 rpm

Transmission:

Make – Allison S1000
Type – 5-speed automatic

Transfer Case:

Make – Atlas

Type – 2-speed gear drive (shift on the fly)

Steering System:

Type – hydraulically assisted.

Axles:

Front – portal axle with selectable diff lock and CTIS-ready.

Rear – portal axle with selectable diff lock and CTIS-ready.

Suspension:

Springs – coil springs, longitudinal arms and panhard rods.

Shock absorbers – double-acting hydraulic.

Brakes:

Service brake dual circuit hydraulic with 4-circuit ABS disc front and rear.

Parking brake spring-applied, pneumatic-release, disc brake operated on rear axle input pinion.

The RG32 Light Tactical Vehicle (LTV), launched in February 2009, is an enhanced mine-protected variant of the successful RG32M Patrol Vehicle, providing even better crew safety and blast survivability. The LTV incorporates a V-shaped hull that protects the crew against armour-piercing rifle fire, anti-tank mine protection level 2a and 2b (under wheel and under centre), and side protection against improvised explosive devices.

RG32 LTV

The RG32 LTV has a gross vehicle mass of only 9.5 tons, classifying it as a light mine-protected 4x4 patrol vehicle, and offers very good mobility and agility.

The Light Tactical Vehicle configuration offers more internal crew space than the conventional RG32M, owing to its 200 mm wider hull and 50 mm increased headroom. Windows are externally mounted, providing improved side-blast protection, while also freeing up space inside the cabin. It also features a newly designed load bay to carry missile-specific equipment. The flexibility of the vehicle allows it to be fitted with mission-specific communications and weapons systems, making it a highly tactical vehicle for operations in various climates and environments.

Ireland was the first country to purchase the RG32 LTV, acquiring 27 units, after two months of intensive field trials, beating European competitors – the Mowag Eagle IV from Switzerland and the Iveco MLV from Italy. The Irish Army will be deploying the Light Tactical Armoured Vehicle (LTAV, as they call this vehicle), specifically to participate in peacekeeping missions abroad in various roles, including surveillance, communications, target acquisition, and transporting the US-made Javelin anti-tank missiles.

The vehicle was launched for the North American market in early 2010, with the designation RG Outrider.

SPECIFICATIONS

Crew:	1 + 4
Dimensions:	
Length	6 000 mm
Width	2 235 mm
Height	2 190 mm
Wheelbase	3 340 mm
Ground clearance	430 mm
Angle of approach	42°
Angle of departure	30°
Mass:	
GVM	9 500 kg
Tare	8 300 kg
Performance:	
Top speed	110 km/h
Grade ability – low-range	60%

Turning circle, curb to curb	17 m
Angle of approach	42°
Angle of departure	30°

Protection Levels:

Ballistic STANAG LEVEL 1 – base vehicle 7.62x39 mm API – with appliqué armour.
Blast – 6 kg TNT under any wheel or under the hull centreline.

Engine:

Make Steyr M16SCI turbocharged intercooled.

Maximum power – 200 kW @ 4,000 rpm
Maximum torque – 610 Nm @ 1,800 rpm

Transmission:

Make – Allison S1000
Type – 5-speed automatic

Transfer Case:

Make – Atlas

Type – 2-speed gear drive (shift on the fly).

Steering System:

Type – hydraulically assisted

Axles:

Front – portal axle with selectable diff lock and CTIS-ready.

Rear – portal axle with selectable diff lock and CTIS-ready.

Suspension:

Springs – coil springs, longitudinal arms and panhard rods.
Shock absorbers – double-acting hydraulic.

Brakes:

Service brake – dual circuit hydraulic with 4-circuit ABS disc front and rear.
Parking brake – spring-applied, pneumatic-release, disc brake operated on rear axle input pinion.

T-Rex

Based on a requirement from India, whose military and police have been successfully using refurbished Casspirs since 1999, the RG Protector 6x6 is essentially an armoured bus which can carry a driver, co-driver and 16 troops. It was not intended as a combat vehicle but to rather offer superb levels of protection to transport military, security and police personnel in areas of high risk.

RG Protector

This robust-looking vehicle was unveiled in August 2011, with its design being based on the battle-proven Casspir. It has a monocoque V-shaped hull contributing to the vehicle's excellent level of mine protection. The RG Protector uses a 6x6 wheeled chassis with Ural suspension. The Protector is powered by a front-mounted Ural YAMZ 236 HE2 engine coupled to a 5-speed manual YAMC-236U Ural manual transmission.

While the use of Russian Ural COTS (commercial-off-the-shelve) building blocks has reduced the cost of the vehicle by a third, the designers of the RG Protector did not compromise on the levels of protection which in fact has the mine protection of much more expensive vehicles.

The commander and driver are seated to the rear of the engine compartment with the commander on the left and the driver on the right. A spare wheel is mounted to each side of the rear hull. Along the sides of both the hulls are six rectangular firing ports and three large bulletproof windows.

The RG Protector has an open architecture and is offered in several variants based on a 6x6 and 4x4 model. It was designed on the same concept for a vehicle developed by BAE Land Systems South Africa for India but with a different market in mind.

SPECIFICATIONS

Crew:	2 + 16
Dimensions:	
Length	7 590 mm
Width	2 670 mm
Height	2 955 mm
Ground clearance	380 mm
Mass:	
Tare	12 520 kg
Payload	1 800 kg
GVM	14 320 kg
Performance:	
Top speed	80 km/h
Grade ability	60%
Turning circle, curb to curb	22 m
Angle of approach	34°
Angle of departure	27°

Electrical System:

Voltage – 24-volt DC
Alternator – 1 x 110 A

Protection Levels:

Ballistic – up to 7.62 mm for crew compartment and part of engine bay.
Blast – crew compartment and part of engine bay.

Engine:

Make – Ural

Model – YAMZ 236 HE2

Displacement – 11 500 cm^3

Maximum power – 169 kW @ 2 100 rpm

Maximum torque – 883 Nm @ 1 200 rpm

Transmission:

Make – Ural YAMC-236U
Type – 5-speed manual

Transfer Box:

Make – Ural

Gear ratios – high 1.21:1 – low 2.15:1

Steering System:

Type – power steering with adjustable steering wheel provided with steering lock.

Axles:

Make – Ural

Suspension:

Springs – leaf springs mounting with cushion stops.

Shock absorbers – double acting.

Brakes:

Main brake systems – dual circuit full air over hydraulic brake system.

Parking brake – spring actuation on propeller shaft.

The RG34 is a further development of the Iguana initially developed by South African specialist design and engineering firm, Industrial and Automotive Design (IAD) for Sabiex, a Belgium military company. This was undertaken as a private venture in 2002.

RG34

The intellectual property in respect of the RG34 vehicle was acquired by OMC in 2009, with an eye to moving back into the more tactical side of the armoured vehicle business after a long period focused on mine-protected and later mine-resistant-ambush protected (MRAP) vehicles for the export market.

The basic RG34 is a compact and agile mine-protected 4x4 APC with provision for an overhead weapon station or one-man turret, and space for a crew of two and six passengers. In the basic configuration it is armoured against 7.62x39 API mm fire at 30 m, an 8 kg mine under any wheel and a 6 kg mine under the belly. All crew seats are side-mounted, with harnesses and foot rests, to protect against the effects of a mine blast. A decentralised NBC system can be integrated with the air-conditioning system. Access is through a rear door, with roof hatches to allow the passengers to fight from the vehicle when required.

Power is from an inter-cooled 160 kW/740 Nm diesel, driving through a five-speed automatic transmission with lock-up and two-speed transfer case. The suspension uses four-link beam axles and hydro-pneumatic struts to give good ride comfort and long suspension travel for off-road mobility, with central differentials for off-road driving. The wheels are fitted with 335/80R20xZL tyres with VFI run-flat inserts, and there are pneumatic disc brakes all-round.

The first variant that OMC intended to develop was a light armoured car or fire support vehicle, using the Eland-90 turret and adapting the vehicle to ensure that it would still fit into a C-130. Any of the Ratel turrets could also be mounted, giving the potential of a 20 mm armed scout car and a ZT4 Ingwe tank destroyer. The basic RG34 obviously also lends itself to use as a command vehicle or ambulance. IAD previously looked at a mortar variant, a 6x6 APC with greater troop capacity and potentially also useful as a forward area logistic vehicle for light mechanised forces, and a lighter amphibious variant.

SPECIFICATIONS

Crew:	1 +7
Dimensions:	
Length	5 050 mm
Width	2 350 mm
Height	2 150 mm
Wheel base	2 900 mm
Ground clearance	340 mm
Wheel track	2 360 mm

Mass:	
Baseline	7 500 kg
Payload	2 000 kg
Combat weight	9 500 kg

Performance:	
Top speed	105 km/h
Gradient ability	60%
Range	900 km

Protection Levels:

Ballistic – STANAG 4569 level 2
Blast – STANAG 4569 level 2A/2B

Engine:

Type – 160 kW turbocharged intercooled

Transmission:

Type – 5-speed automatic with lock-up

Transfer Box:

Type – 2-speed

Brakes:

Type – pneumatic disc brakes
Brakes – ABS standard

The RG35 6x6 infantry fighting vehicle, nicknamed ‘Bigfoot’ by its designers, was developed as the forerunner of what BAE saw as a new class of ‘cross-over’ vehicles, combining the mine and IED protection of a top-end mine-resistant ambush-protected vehicle with good ballistic protection and real operational and tactical mobility.

Infantry Fighting Vehicle
RG35 6x6

Development of the RG35 series began in 2008 with the 6x6 infantry fighting vehicle (IFV) being unveiled to the public in September 2009 at the Defence Systems and Equipment International Exhibition in London. Since then the series has been expanded to include the 4x4 Recce Patrol Utility (RPU) in May 2011 and the 4x4 Motorised Infantry Vehicle (MIV) in May 2014.

The RG35 6x6 IFV has a 1+2 axle layout and the power pack on the left of the vehicle behind the driver. It has driver’s and co-driver’s seats forward, space for a small turret or overhead weapons station alongside the power pack (or three additional seats) and up to 13 seats in the back. The main access is through a rear door, and there are driver’s and co-driver’s doors. Roof hatches allow passengers to fight from the vehicle and provide an emergency escape route.

A very compact power pack and careful design have resulted in a vehicle with 15 m^3 under armour and an exceptionally uncluttered interior, with good intervisibility that supports crew cohesion, even with a weapon station installed. Large windows provide all-round visibility for situational awareness, and a climate control system ensures a degree of comfort even when ‘buttoned up’.

The full-length V-shaped hull, except a section under the power pack, protects against a 10 kg mine under the belly or under any wheel, and side-mounted, shock-absorbing seats with foot rests add to crew protection. The basic protection can be reinforced with applique armour to protect against 14.5 mm AP fire and 155 mm fragments. The windows protect against 12.7 mm fire and are externally mounted to prevent them being blown into the troop compartment by a pressure wave. Spall liners can be fitted, as can a fire-suppression system.

BAE stayed with the 1 +2 axle layout of the Ratel, believing that its advantages more than offset the better ditch-crossing capability of an evenly-spaced 6x6: it avoids the rocking and heavy vertical accelerations of an even 6x6 when crossing humps (seesaw effect); it allows bigger wheels for a given vehicle size (important for cross-country mobility); it is better for long-distance road moves (better steering, less pitching); and it is substantially cheaper than the two steered axles of either an evenly-spaced 6x6 or an 8x8 vehicle.

The power pack is designed to accommodate various engine options up to 550 hp and 2136 Nm, using Cummins or CAT diesels driving through a ZF 6Hp 602/902 six-speed automatic transmission with hydrodynamic retarder and two-speed permanent 6x6 transfer box. Two inspection hatches provide access to all regular power pack maintenance points and to critical components, and the entire power pack can be removed in less than 30 minutes. The vehicle is also designed for hybrid electric-drive .

The electrical system generates u p to 38 kW (24V DC), to provide an ample supply for onboard equipment and systems. All main vehicle functions are controlled using an MFD and six I/O nodes, and the vehicle has an onboard diagnostics system.

The running gear uses high-capacity beam axles with hub reduction, four-link hydropneumatic suspension and hydraulically assisted steering. Central tyre inflation and ride height management systems can be incorporated. The brakes are pneumatic dual-circuit service brakes with discs and ABS all-round, and a pneumatic release-spring parking brake on the rear axles. The vehicle can be fitted with 395/85R20, 14.00R20 or 16.00R20 wheels with standard run-flat inserts.

It can be configured for use in a variety of combat roles such as a command post vehicle, an engineering vehicle, a mortar vehicle, an anti-aircraft vehicle, a recovery vehicle or even an ambulance.

SPECIFICATIONS

Crew:	2 + 13
Dimensions:	
Length	7 161 mm
Width	2 600 mm
Height	2 658 mm
Ground clearance	420 mm
Mass:	
Tare	15-500 kg
Payload	8 500 kg
GVM	24 000 kg
Performance:	
Top speed	105 km/h
Grade ability	>60%
Turning circle, curb to curb	16 m
Angle of approach	53°
Angle of departure	44°

Protection Levels:

Ballistic – up to STANAG4569 A level 4
Blast – upto STANAG4569 B level 4A/4B
IED – side protection level undisclosed

Engine:

Make – Cummins ISL

Maximum power 336 kW/450 hp

Maximum torque 1 620 Nm @ 1 995 lbf.ft

Transmission:

Make -ZF Hp602, 6-speed automatic

Axles:

Make-AxleTech

Suspension:

Type – double control arm, independent. Spring damper-hydro-pneumatic strut. Ride height adjustment 4-stage with display.

Electrical System:

Voltage-28-volt DC

Power – generation up to 600A

The RG35 RPU is a tactical 4x4 wheeled vehicle that is built for multiple missions. The reconnaissance variant can be equipped with light and medium turrets, as well as direct- and indirect-fire weapons; it has an excellent off-road capability.

Reconnaissance Patrol Utility
RG35 4x4

The vehicle has been designed to be modified in a number of ways to transport cargo, conduct routine patrols, or to be fitted out with cameras and other electronics for surveillance work. The platform was adapted to be a contender for the Canadian Army's 4x4 Tactical Armoured Patrol Vehicle (TAPV) programme that was eventually awarded to the Canadian company Textron Systems Inc. to replace the RG31s in service with the Canadian Army.

SPECIFICATIONS

Crew:	1 +9
Dimensions:	
Length	5 450 mm
Width	2 630 mm
Height	2 595 mm
Wheel base	3 030 mm
Ground clearance	414mm
Wheel track	2 176 mm
Mass:	
Tare	12 200 kg
Payload	5 800 kg
GVM	18 000 kg
Performance:	
Top speed	105 km/h
Range	1 000 km
Grade ability	>60%
Turning circle, curb to curb	14.5 m
Angle of approach	53°
Angle of departure	45°

Protection Levels:

Ballistic – up to STANAG A 4569 level 4
Blast – up to STANAG B 4569 level 4A/4B
IED – side protection level undisclosed

Engine:

Make-Cummins ISL

Maximum power – 336 kW 7450 hp

Maximum torque – 1 620

Transmission:

Make – ZF Hp602
Type – 6-speed automatic

Axles:

Make – Axle Tech

Suspension:

Type – double control arm, independent. Spring damper – hydro-pneumatic strut.

Ride – height adjustment 4-stage with display.

Electrical System:

Voltage – 28-volt DC

Since the RG35 MIV was designed for motorised infantry, it features shooting ports, a tapered windscreen for good, all-round observation and rapid egress points: an escape hatch above the driver, a rear door or ramp and a roof hatch, while a side door is optional. The pneumatics, hydraulics, fuel and batteries are all ballistically protected. In addition, the vehicle is IED resistant and can withstand a 50 kg charge at a distance of! metre.

Motorised Infantry Vehicle

RG35 4x4

An overpressure system provides protection against chemical, biological, radiological and nuclear threats.

The RG35 MIV has various weapons options, including a two-man turret or remotely operated weapon system featuring a 40 mm automatic grenade launcher and 7.62 mm machine gun. The vehicle features seating for the driver and co-driver and between six and eight infantry in the back.

The RG35 MIV has a 2.4 m roof height that can be lowered to 2.25 m for transport purposes, which together with an empty mass of 14.1 tons, allows transportation by C-130 or similar aircraft.

SPECIFICATIONS

Crew:	1 +8
Dimensions:	
Length	5 964 mm
Width	2 600 mm
Height – dynamic	2 407 mm
Wheel base	3 350 mm
Ground clearance	443 mm
Mass:	
Tare	14 100 kg
Payload	6 900 kg
GVM	21 000 kg
Performance:	
Top speed	105 km/h
Grade ability	>60%
Turning circle, curbtocurb	15m
Angle of approach (min)	53°
Angle of departure (min)	38°
Protection Levels:	
Ballistic – up to STANAG 4569 A level 4 Blast – up to STANAG 4569 B level 4A/3B	

IED-side protection

Engine:

Make-Cummins ISL

Maximum power – 336 kW/450 hp

Maximum torque – 1 620 Nm @ 1 995 lbf.

Transmission:

Make-ZF Hp602; 6-speed automatic integrated retarder

Steering System:

Type ZF Servocom – hydraulically

assisted

Axles:

Make AxleTech

Suspension:

Type – double wishbone, independent. Spring damper – hydro-pneumatic strut.
Ride – height adjustment 4-stage with display.

Brakes:

Service brake – Wabco air actuated disc brakes

Emergency brake – spring actuated Pneumatic release – 60% grade ability

Electrical System:

Voltage – 28-volt DC
Power generation – 600A
Digital body control system Onboard diagnostics

Armour Technology Systems (Pty) Ltd (ATS), was a small South African design and development company formed in 2004 specifically for MRAP vehicles, which they believed would offer the best in its class protection for light armoured personnel carrier applications for the conflicts in Iraq and Afghanistan.

ORYX

The Oryx 4x4 offered high mobility, with good ballistic protection against small-arms fire and multiple tank-mines as well as protection against IEDs.

Looking for a suitable North American partner for the Oryx vehicle to be manufactured in the US, ATS finally entered into a joint venture with Navistar Defence in March 2005.

During the US Army evaluation at Fort Knox in February – March 2006 of vehicles that could offer solutions to their problems in Iraq and Afghanistan, more than 140 vehicles were initially studied. Of these only 30 were invited for evaluation, with five being eventually invited for The 'long run'. The Oryx was one of these vehicles that was finally selected and after a few modifications immediately went into production.

The initial order by the US to upgrade the Iraqi Army was for some 200 vehicles.

SPECIFICATIONS

Crew:	2 + 8
Dimensions:	
Length	5716 mm
Width	2 300 mm
Height	2 477 mm
Wheel base	3 555 mm
Ground clearance	420 mm
Mass:	
GVM	8 875 kg
Payload	6 025 kg
Performance:	
Top speed	120 km/h
Grade ability	70% Low range
Turning circle, curb to curb	16 m
Angle of approach	46°
Angle of departure	45°

Protection Levels:

Ballistic – 7.62x54 mm AP

Blast – 1 x TM-57 under hull, 2 x TM-57 under any wheel.

Engine:

Make – international V8 diesel
Type – turbo after-cooled, direct electronic injection, four stroke.
Maximum power – 227 kW (300 hp) @ 3300 rpm
Maximum torque – 729 Nm (540 ft/lb) @ 2000 rpm

Transmission:

Make – Allison 2500
Type – automatic 5-speed

Transfer box:

Make – ZF 2-speed

Steering system:

Steering type – hydraulically assisted recirculating ball.

Axles:

Make – Marmon-Herrington R17
Type – planetary hub reduction with pneumatic operated diff locks.

Suspension:

Springs – semi epileptic leaf springs.
Shock absorbers – double acting, telescopic, hydraulic.

Brakes:

Service brakes – full air brakes with ABS.
Parking brakes – pneumatic activated hand operated on rear drums.

Electrical:

Batteries 12-volt

In 2004, Drakensberg Truck Manufacturers (DTM), were approached by a North African client to supply an armoured personnel carrier with similar specifications to the Mamba, which at the time was no longer commercially available.

SPRINGBUCK

DTM went about creating a new vehicle in this popular light armoured personnel carrier category.

A key design criterion for the Springbuck IV was to have a tough, reliable vehicle suitable for African conditions.

The Springbuck IV has an all-steel armoured V-shaped hull which can withstand the explosion of a TM-57 landmine directly under the hull, or two mines under any wheel. The vehicle offers B6 level of ballistic protection, while the protection can be upgraded to B7 level.

DCD Protected Mobility acquired the Springbuck IV data pack from DTM in 2012.

After a complete redesign with many technology improvements on the Springbuck IV, DCD Protected Mobility developed a second variant, the Mk VI. This vehicle, known for its toughness and sure-footed dexterity is affordable but not inferior, providing African clients

with an MRAP equivalent that is ideal for a broad spectrum of security applications. The most noticeable difference is that the Mk IV has a single rear door and is powered by a four-cylinder engine, while the Mk VI has three doors, two up front for driver and co-driver and one at the rear, integrating a six-cylinder engine.

The Springbuck family of vehicles come with a modular design allowing it to be easily configured to suit a variety of roles such as command, tactical ambulance, cash-in transit, riot control or tactical patrol. The integration of turret-mounted weaponry allows the vehicle to conduct combat operations. The vehicle uses COTS for its drive-line parts, making it easy for maintenance and component sourcing.

The driver and co-driver sit up front, while the rear compartment carries up to nine troops who gain access via a rear entry door. The troop compartment has large armoured glass windows with gun ports. Both vehicles are available in either left- or right-hand drive.

A number of African countries operate the Springbuck including the Nigerian Police who, as of 2014, has a fleet of 44 Springbuck Mk VI APCs that are deployed to high-risk areas on patrol missions.

SPECIFICATIONS

Crew:	1 + 10
Dimensions:	
Length	5 900 mm
Width	2 360 mm
Height	2 720 mm
Ground clearance	350 mm
Mass:	
Curb weight	7 500 kg
Payload	1 500 kg
GVM	900 kg
Performance:	
Top speed	110 km/h

Gradient ability	70%
Range	700 km
Angle of approach	42°
Angle of departure	48°

Protection Levels:

Ballistc – 6 mm armoured steel and optional bolt-on armour V-shaped monocoque armoured steel hull.
Blast – single TM-57 under the hull or double TM-57 under any wheel.

Engine:

MWM 6.10T 6-cylinder turbo diesel 144kW, 632 Nm

Transmission:

Allison 1000SP automatic

Transfer Box:

Axle tech T232 transfer tranmission with low range.

Brakes:

Pneumatic dual circuit
ABS

The Mountain Lion was first shown to the public in 2011. For DCD who are world-renowned for their innovative ‘Chubby’ combat-proven landmine-detection system, also known as the Vehicle Mounted Mine Detector (VMMD), the development of an armoured vehicle represented a new era for the company. The design of the Mountain Lion has been based on lessons learned by the US and other countries from years of war in Iraq and Afghanistan, the US having been one of DCD’s biggest customers for the VMMD armoured route-clearance vehicle.

MOUNTAIN LION

The Mountain Lion’s design incorporates a monocoque V-shaped armoured hull. This ensures maximum protection from blast threats and offers superb ballistic protection against conventional ammunition and IEDs. AII the sub-systems are enclosed within the hull, which includes the entire drive train, engine, transmission, transfer transmission, electrical and pneumatic system, providing protection from mine or IED blasts. The vehicle can carry a crew of up to two plus eight soldiers complete with their kit and special equipment for at least a 48-hour combat mission. The cabin has two side doors and one rear door.

Tactical mobility, crew comfort and improved mission endurance is achieved through the combination of a powerful 300 hp engine coupled with a six-speed automatic transmission, double wishbone fully independent suspension and intelligent damping. The Mountain Lion is equipped with a unique four-wheel steer system, reducing the turning circle to 12 m and thus enhancing the Mountain Lion’s mobility in close terrain and urban areas. The four-wheel steer system has been combat-proven in Iraq and Afghanistan on the Husky VMDD.

The use of COTS in the Mountain Lion simplifies maintenance and logistics support. The Mountain Lion’s ample load capacity allows it to fulfil command and control functions as well as route clearance and combat support roles. Easy access and egress is through pneumatically assisted side and rear doors. Water White clear armoured windows provide excellent all-round visibility. A robust ring bearing assembly easily accepts a weapons station or turret of the customer’s choice.

The Mountain Lion has also successfully completed arduous and comprehensive testing conducted in South Africa, the Chelsea Proving Grounds in Detroit in 2010 and the Nevada Automotive Test Centre, near Carson City, in 2011. In 2012 the vehicle participated in the northern Summer Trials in the United Arab Emirates where it passed with flying colours.

القوات المسلحة
تحت التجربة ١٣

SPECIFICATIONS

Crew:	2 + 8
Dimensions:	
Length	5 900 mm
Width	2 510 mm
Height	2 680 mm
Wheel base	3 800 mm
Ground clearance	445 mm
Mass:	
Curb weight	11 750 kg
Payload	3 250 kg
GVW	15 000 kg
Performance:	
Top speed	110 km/h
Range	>700 km
Maximum gradient	70%
Angle of approach	42°
Angle of departure	55°

Protection:

Ballistic – 6 mm armoured steel and bolt-on ceramic tiles.

Blast-15 mm, 80°, V-shaped monocoque armoured steel hull.

Engine:

Make and model – Cummins QSB6.7
Type – turbo, inter-cooled, diesel, four stroke, inline 6-cylinder.

Displacement – 6700 cm^3
Maximum power – 268 kW @ 2600 rpm

Maximum torque – 1100 Nm @ 1 400 – 2 300 rpm

Transmission:

Make and model – Allison 3000SP
Type – automatic
Speeds-6 forward, 1 reverse
Shift selector – push button

Transfer Box:

Make and model – ZF VG750, with differential lock.

Steering system:

Front and rear (4 wheel) permanent mechanical steer with dual hydraulic assist.

Minimum turning circle – 12.5 m

Independent Suspension Axle Units (front and rear):

Make and model – AxleTech series 4000
Maximum weight rating – 7000 to 9000 kg (depending on spring rating).
Suspension travel – 350 mm

Brake System:

Pneumatic brake system
ABS
Disc brakes

This vehicle is the second in the KF family of new generation Mambas manufactured by N4 Trucks, outside Pretoria. The front of the body is slightly different in design to accommodate the Magirus/Iveco powertrain. While almost similar in shape and specifications, its Magirus/Iveco air-cooled powertrain makes this KF slightly heavier by 500 kg. This vehicle is also a little shorter in length. Its reduced top speed of 94 km/h increases its range over the KF 411 by 200 km. Its spare tyre is also mounted centre on the left side of the hull.

KF 409

SPECIFICATIONS

Crew:	2 + 9
Dimensions:	
Length	5 140 mm
Width	2 450 mm
Height	2 700 mm
Wheel base	3 250 mm
Ground clearance	430 mm
Mass:	
Tare	9 050 kg
GVM	14 900 kg
Performance:	
Top speed	94 km/h
Gradient ability	70%
Turning circle	14m

Protection levels:

Ballistic – B7, STANAG 4569, level 3
Blast – 10 kg TNT anywhere under the hull and 14 kg under any wheel.

Engine:

Make – Magirus/IVECO
Model – Deutz BF6L913F turbo
Cylinders – in-line 6
Power – 124 kW @ 2 650 rpm
Torque – 717 Nm @ 1 600 rpm

Transmission:

Type – S6-36 synchromesh gearbox
Gears-6 forward, 1 reverse
Automatic Allison optional
Transfer case – Z65 with high and low ratios.

Suspension:

Front – semi elliptic leaf springs
Rear – semi elliptic leaf springs with anti-roll bar.

Axle:

Front axle – Magirus/IVECO

Capacity – 5 900 kg

Rear axle – Magirus/IVECO

Capacity – 9 000 kg

Brakes:

Front and rear – drum dual circuit
Pneumatic air brakes

The KF 410 evolved from the Casspir Mk II. While retaining the deep V-shaped monocoque hull, the KF 410 is a completely new design by N4 Trucks upgrading its armour, powertrain and large outside stowage bins. The hull is also folded into shape reducing the number of welded joints, thus significantly strengthening the body against a blast.

KF 410

The KF 410 can carry up to ten troops, as well as a driver and co-driver who gain access through a double rear door. It has a useful payload of 4.5 tons and combined with its high ground clearance and automatic 6-speed Allison transmission box, this makes the KF 410 a very capable off road vehicle.

It is available as an ambulance, armoured personnel carrier or command unit.

SPECIFICATIONS

Crew:	2 + 10
Dimensions:	
Length	6 907 mm
Width	2 557 mm
Height	2 690 mm
Wheel base	3 945 mm
Ground clearance	400 mm
Mass:	
Tare	11 500 kg
GVM	16 000 kg
Performance:	
Top speed	110 km/h
Range	750 km
Gradient ability	70%
Approach angle	33°
Departure angle	450

Protection levels:

Ballistic – able to with stand 7.62 mm x 54 API

Blast – 10 kg anywhere under the hull and 14 kg under any wheel.

Engine:

Make – Cummins
Model-QSB 6.7
Cylinders-in-line 6
Power – 205 KW @ 2 500 rpm
Torque – 990 Nm @ 1 500 rpm

Transmission:

Type-Allison 3000
Gears – 6 full automatic
Automatic Allison optional

Transfer Case: Axle Tech T600

Suspension:

Front – aemi elliptic leaf springs
Rear – semi elliptic leaf springs

Axle:

Front axle – Axle Tech capacity – 7 000 kg
Rear axle – Axle Tech capacity – 9 000 kg

Brakes:

Front and rear – drum dual circuit
Pneumatic air brakes

Manufactured by N4Trucks, the KF 411 is considered a new-generation Mamba, based on the heritage of that successful line of vehicles. The vehicle has been completely redesigned with an Iveco drive train. The KF 411 has roof hatches with options for additional roof mounts and turrets. It has outside storage compartments on both sides of the hull.

KF 411

Its V-shaped monocouque hull offers all-round blast protection levels that can withstand 12 kg of TNT.

The KF 411 is in use with the United Nations where it has proved to be a very effective vehicle in Somalia.

SPECIFICATIONS

Crew:	2 + 9
Dimensions:	
Length	5 240 mm
Width	2 450 mm
Height	2 700 mm
Wheel base	3 250 mm
Ground clearance	430 mm
Mass:	
Tare	9 640 kg
GVM	14 000 kg
Performance:	
Top speed	114 km/h
Gradient ability	70%
Turning circle	14 m

Protection levels:

Ballistic – B7, STANAG 4569, level 3
Blast – 10 kg anywhere under the hull and 14 kg under any wheel.

Engine:

Make – IVECO

Model-Tector F4AE068IB

Cylinders – in-line 6

Power – 179 kW @ 2 7001 pm

Torque – 810 Nm @ 1 200 – 2 100 rpm

Transmission:

Type – Eaton FSO 5206B
Gears – 6-speed synchromesh
Automatic Allison optional
Transfer case – ZF Iveco TC700

Suspension:

Suspension – front

Semi elliptic leaf springs with anti-roll bar.

Rear – semi elliptic leaf springs with anti-roll bar.

Axle:

Front axle – Iveco 5956 CS
Capacity – 5 500 kg
Rear axle – Iveco 451046
Capacity -9 500 kg

Brakes:

Front and rear – drum dual circuit

Pneumatic air brakes

KF · 47

The KF 47, the latest vehicle from N4 Trucks is, also their first to offer a front door for the driver and codriver. With a turning circle of just under 12 metres this makes the KF 47 ideal for urban operations. This vehicle has good all-round visibility with a single large front windscreen, one on each side door, three windows along both sides of the hull and one in the rear door. The troop windows all have firing ports. There is plenty of space for storing personal gear in the large external storage bins on both sides of the hull.

KF 47

The KF 47 carries a crew of driver and co-driver and ten troops who have access through the rear door. Troop seating arrangement is facing inwards. There are four hatches and one turret.

The vehicle can also be configured into an ambulance which can accommodate driver, co-driver, four crew and four stretchers. The rear access door can be specified as a hydraulic ramp door which eases the loading of patients into the ambulance.

SPECIFICATIONS

Crew:	2 + 10
Dimensions:	
Length	6 982 mm
Width	2 538 mm
Height	2 862 mm
Ground clearance	540 mm
Mass:	
Tare	9 800 kg
GVM	14 000 kg
Performance:	
Top speed	110 km/h
Range	850 km
Turning circle, curb to curb	12 m
Gradient ability	70%

Engine:

Make – IVECO
Model – Tector F4AE0681B
Cylinders – in-line 6
Power – 179 kW @ 2 700 rpm
Torque – 810 Nm @ 1 200 – 2 100 rpm

Transmission:

Type – Allison 3000
Automatic Allison optional
Gears – 6 automatic

Transfer Case: ZF-Iveco TC700

Suspension:

Front – semi elliptic leaf springs with anti-roll bar.

Rear – semi elliptic leaf springs with anti-roll bar.

Axle:

Front axle – Iveco 5956 CS
Capacity – 5 500 kg
Rear axle – Iveco 451046
Capacity – 9 500 kg

Brakes:

Front and rear – drum dual circuit
Pneumatic air brakes

As was so cruelly exposed with the coalition forces operating in Iraq and Afgansitahan, it is just as important to protect personnel operating an armoured battle tank as it is those operating logistic support vehicles. Logistic vehicles form the backbone of any deployed operation, while history has repeatedly shown that when re-supply operations fail, armies falter.

Heavily Armoured Protection Cabs

It became apparent that many of the non-combat support vehicles operating within these two countries in hostile conditions were considered inadequate and 'soft skinned', falling a long way short of providing the required high levels of crew protection that incorporated mine-blast resistance and protection against both IEDs and ballistic threats.

South African company Land Mobility Technology (LMT) identified this need and formed a partnership with Mercedes Benz to provide state-of-the-art armoured and mine-protected cabs for their range of 6x6 and 8x8 Actros trucks.

The cab was initially developed to meet the South African Army's requirement for an armoured and mine-protected cab to be fitted to about half of the planned fleet of new tactical trucks (Project Vistula).

The cabs have been designed to give ballistic protection to STANAG 4569 Level 1, 2, 3 or 4 multi-shot, landmine protection up to STANAG 4569 level 4a/4b and IED protected against the detonation of 50 kg TNT 2 m from the side of the vehicle, 1 m from ground level (all protection tested and certified by the CSIR/Armsocr). The cab makes use of 'flat bottom' technology. In essence this relies on absorbing blast and shock rather than on deflecting it as with the traditional V-shaped hull. While details of this South African innovative technology have not been released, it is known to use a combination of an armoured floor structure – comprising a sandwich of armour and shockabsorbing material – and shockabsorbing and attenuation features in the design of the exterior mounting and internal structures and fittings.

The seats are mounted on the rear wall of the cab to prevent the direct transfer of shock from the under-floor blasts and have four-pointed harnesses, head rests and special footrests to further attenuate the effect of the blast and possible roll over. The cab has a water chiller for the crew, air ride seats and a good field of vision through the bulletproof windscreen allowing the crew good all-round situational awareness.

Attention has also been paid to the secure stowage of personal equipment and weapons inside to prevent such equipment becoming a source of injury in the event of a blast affecting the vehicle.

These heavily armoured protection cabs are manufactured by LMT in Pretoria, South Africa, then dispatched to Germany where they are fitted to an all-terrain Actros truck chassis, producing an Armoured Heavy Support Vehicle System offering high levels of protection and heavier payloads than previously available.

The 4-axle (8x8) all-terrain Actros is based on the series production which are in use by over 50 armies providing service in long haulage, heavy duty construction, as semitrailer tractors and in logistic operations.

LMT has created a whole family of heavily armoured cabs for the Actros and other Mercedes Benz trucks such as the Unimog and Zetros that are suitable for a wide range of applications in unstable crisis areas.

The lead customer for these highly armoured, robust and heavy duty logistic vehicles was the Canadian Defence Ministry. In 2007 they initially ordered 83, followed by another 13 Mercedes Benz Actos trucks with the heavily armoured cabs for use in Afghanistan to provide optimum protection to the Canadian soldiers operating there. These cabs are also in use with the German Bundeswehr and three further undisclosed countries.

ISAF

49F1

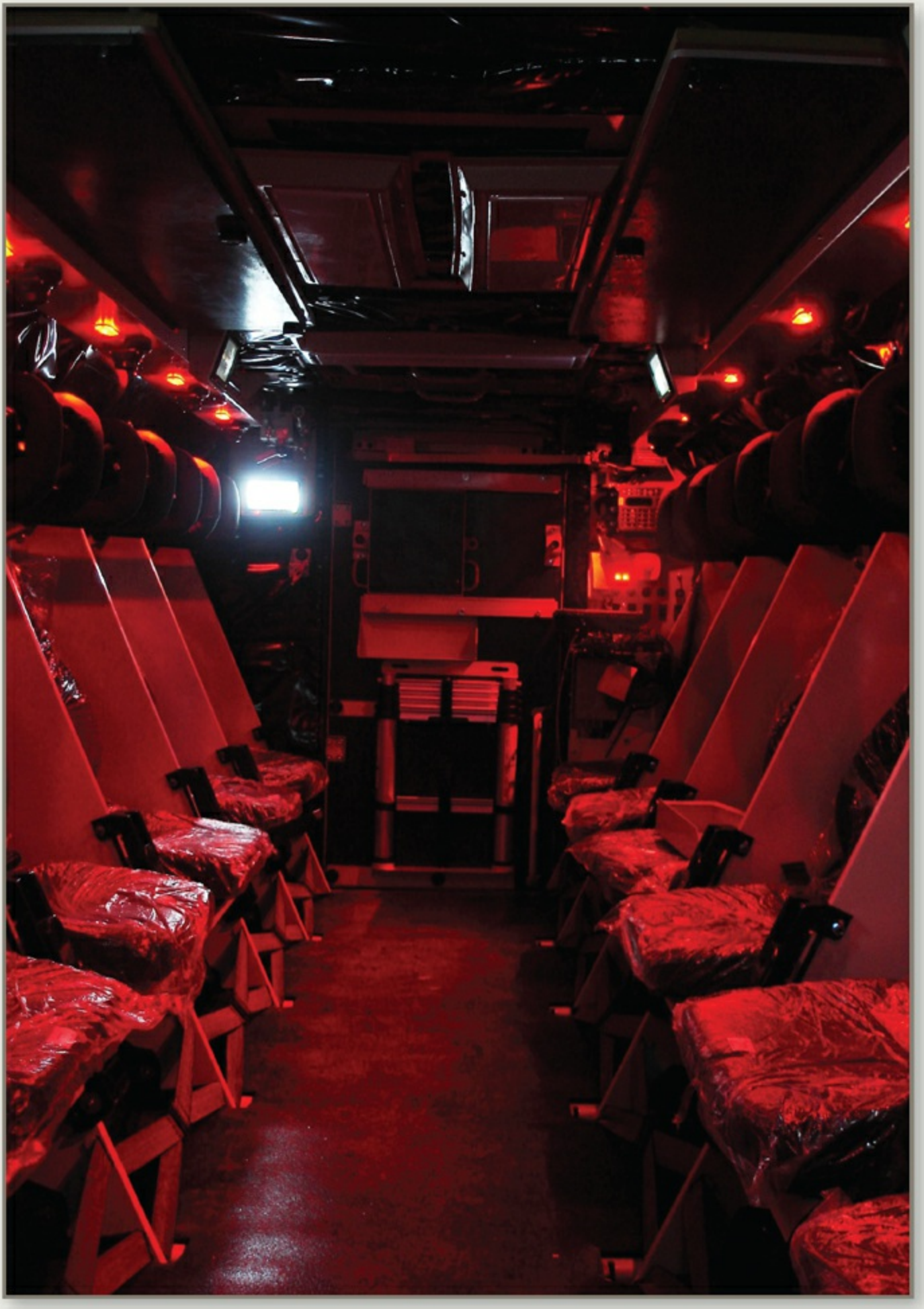
Transporting soldiers, civilians and general logistics in crisis-hit regions constitutes a high risk, as was seen almost every day with the coalition forces operating in Iraq and Afghanistan. To counter this threat, Land Mobility Technologies developed an innovative armoured and mine-protected personnel transport container with very high levels of protection.

Armoured Personnel Transport Container

With a seating capacity of 15 people plus equipment, it offers a capacity and comfort level more than that found in most armoured vehicles. The LMT armoured personnel transport container is in use by several NATO countries and is combat-proven in various theatres.

The LMT armoured personnel transport container has been designed to provide ballistic protection to STANAG 4569 Level 1, 2, 3 or 4 multi shot, landmine protection up to STANAG 4569 Level 4a/4b and IED protected against the detonation of 50 kg TNT 2 m from the side of the vehicle, 1 m from ground level. The container also makes use of ‘flat bottom’ technology. In essence this relies on absorbing blast and shock rather than on deflecting it as with traditional V-shaped hulls. While details of this South African innovative technology have not been released, it is known to use a combination of an armoured floor structure – comprising a sandwich of armour and shockabsorbing material – and shock-absorbing and attenuation features in the design of the exterior mounting and internal structures and fittings.

The seats are mounted on the side walls of the containers to prevent the direct transfer of shock from the under-floor blasts and have four-pointed harnesses, head rests and special footrests to further attenuate the effect of the blast.



The container is transportable on 6x6 and 8x8 trucks as well as in a C-130 Hercules. A

hook-loading system makes it possible to load and unload the LMTarmoured personnel transport container quickly for transportation by air, rail or sea.

In comparison to armoured transport vehicles, the LMT armoured personnel transport container system offers significant advantages with regard to cost saving in operational and maintenance costs by optimizing the ratio between the number of passengers and drivers.

The LMT armoured personnel transport container has been used successfully in Afghanistan in providing secure and comfortable transport for personnel along routes threatened by ambush, sniping, IEDs and mines.

Two variants are available in addition to the normal armoured transport container, namely a command centre and mobile field hospital.

SPECIFICATIONS

Protection:

Ballistic – up to STANAG 4569 level 4, 14.5 mmx 144 API/B32 – certified by TNO (Netherlands).
Landmine – up to STANAG 4569 level 3a/3b (8 kg TNT) – certified by Armscor/CSIR.
I ED – up to 50 kg TNT, 5 m from the vehicle, 1 m from the ground – certified by Armscor/CSIR.
EMI-compliant with MIL-STD-810.

Dimensions and mass:

ISO – standard 6.1 m container, 2.4 m in width and 2.1 m high with an empty weight of 8.6 tons and maximum weight of 11.6 tons.

Seating:

Up to 15 persons in personnel carrier variant.

Other:

100 litre water tank or chiller
32 kW APU for electrical power
24 kW air condition system
10 kW diesel powered heaters
6 lockable storage bins outside, sufficient packing space inside for personal weapons and kit.
4 cameras outside and 4 screens inside for situational awareness.
Access through hydraulically operated door and two roof hatches.
Flood lights, personal lights, black out lights and emergency lights inside container.

With all its combat-proven ability in Iraq, it comes as no surprise that the REVA III 4x4 LWB is one of the Integrated Convoy Protection company's (ICP) most popular vehicles. These are the most cost-effective and economical armoured vehicles in ICP's range. The REVA III is a low-maintenance MRAP vehicle capable of operating under all conditions. Its mechanical system is user-friendly and easy to operate with little logistical support. The vehicle's V-shaped monocoque hull offers protection against landmines and IEDs.

REVA III 4x4 LWB

The vehicle is able to carry eight soldiers and a crew of two who gain access through a rear door. The REVA III LWB can be fitted with an open top turret mounted on the roof of the crew compartment which can be armed with a 7.62 mm or 12.7 mm machine gun.

SPECIFICATIONS

Crew:	2 + 8
Dimensions:	
Length	6 200 mm
Width	2 520 mm
Height	2 600 mm
Ground clearance	300 mm
Mass:	
TARA	9 500 kg
GVM	10 800 kg
GCM	25 000 kg
Performance:	
Top speed	100 km/h

Grade ability	50%
Angle of approach	28°
Angle of departure	40°
Turning circle, curb to curb	15.9 m

Protection Levels:

Ballistic – B6+

Blast – STANAG 4569 level 3B
IED/EFP – 12 mm (6 mm armour protection plate with 6 mm secondary armour skin).

Engine:

Maximum engine output 115 – 125 kW (170 Bhp) @ 2 500 rpm
Maximum Torque 590 – 700 Nm @ 1 500 – 2 700 mm

Transmission:

Type sutomatic, 5 forward and 1 reverse Model Allison 2500 SP

Transfer Box:

Gearbox constant mesh

Axles:

Front axle – rigid single reduction steering axle.

Rear axle – rigid single reduction with differential lock.

Suspension:

Type – semi-elliptic leaf springs and double acting telescopic shock absorbers.

Brakes:

Service brakes – full air dual circuit.
Parking brake – air assisted spring brakes on 4 wheels.

Electrical System:

Voltage 24-volt

The ICP REVA ambulance has a rear door that opens downwards, providing steps for easy access by patients and medical attendants. There are two front doors for the driver and co-driver. Along the sides of the rear compartment of the ambulance are four bulletproof windows. Above the driver's cab is a turret.

REVA Ambulance

The roofline of the rear compartment has been raised by 30 cm, providing more room for the medical attendants to treat patients. Its standard features include an air-conditioner unit, extractor fan, hand washbasin with running water and a siren with strobe lights. It can take a crew of two and eight personnel or a crew of two with four stretchers.

SPECIFICATIONS

Crew:	2 + 8or2 + 4stretchers
Dimensions:	
Length	6 330 mm
Width	2 630 mm
Height	2 850 mm
Ground clearance	300 mm
Mass:	
Tara	8 250 kg
Performance:	
Speed	100 km/h
Protection levels:	
Ballistic – B7 Blast – STANAG 4B	
Engine:	
Maximum power-115-125 kW (170 Bhp) @ 2 500 rpm	
Maximum Torque – 590-700 Nm @	
1 500 rpm – 2 200 rpm	
Transmission:	

2 500 SP automatic

Transfer Box:

2-speed selectable 4x4

Axle:

Front – single reduction rigid steering axle.

Back-double reduction rigid axle with differential lock.

Electrical System:

Voltage -24-vo lt

REVA V

The REVA V which was launched in 2008 is the biggest armoured vehicle in the ICP stable. One significant difference between the REVA V and similar vehicles in this size is the construction of the V-shaped monocoque hull. The hull consists of three moulded steel plates with two plates welded along the top of the hull in the middle, forming the upper hull while the third plate overlaps the other two plates, forming the bottom of the hull. A capping plate on the inside of the lower part of the hull doubles the thickness of the lower hull to better resist bombs and mines.

REVA V 4x4 LWB

This doubles the thickness of the lower hull to better resist roadside bombs and mines. There are no welded corners, just roundings as welds are not as strong or blast resistant.

The REVA V has two 500 litre external storage bins, air-conditioning and a rotating turret with an escape hatch. The crew gain access through two front side doors or the single rear door.

SPECIFICATIONS

Seating:	2 + 8
Dimensions:	
Length	6 150 mm
Width	2 570 mm
Height	2 700 mm
Wheel base	3 430 mm
Ground clearance	400 mm
Mass:	
Tara	12 250 kg
Payload	1 500 kg
GVM	13 750 kg
Performance:	
Top speed	100 – 110 km/h
Grade ability	60%
Side slope	35°
Step climb	500 mm
Fording	800 mm @ 10 km
Road range	550 km @ 80 km/h
Angle of approach	36°
Angle of departure	40°
Turning circle, curb to curb	16.3 m

Protection Levels:

Ballistic – up to BSN EN 1522 level FB7 and BS EN 1063 level BR7.

Blast – up to STANAG 4569B level 4a and 4b.

IED/EFP – 8.9 mm armour protection plate on the sides.

Engine:

Model – Cummins ISB 6, 7

Type – 4-stroke turbo charged with inter-cooler.

Number of cylinders – 6 in-line
Displacement – 6.7L
Max gross power – 223 kW @ 2 200 rpm
Max gross torque – 1 160 Nm @ 1 600 rpm

Transmission:

Model – Allison 3 000 automatic –

6 forward and 1 rear

Transfer Box:

ZF VG 750

Axles:

Front – fully independent Axletech
Rear – fully independent Axletech

Wheels :

Rim and wheels – 10x20 split rim 365/85xR20 wheel with runflat (RFI) and central tyre inflation (CTIS).

Suspension:

Fully independent with coil springs and shock absorbers.

Brakes:

Service brake – pneumatic dual circuit disc brakes with ABS and EVB, engine exhaust brake.

Parking brake – spring actuated on rear axle.

REVAV
AME

Master Sergeant Samran Kongkul of the Royal Thai Army was travelling in a REVA armoured personnel carrier in southern Thailand on his way to engage a group of insurgents when his vehicle detonated an improvised explosive device. He takes up the story…

I survived the ride

I was deployed in Narathiwat, the southern region of Thailand to help calm the situation in the three provinces of Patani, Yala and Narathiwat.

With the ongoing insurgency problems in that southern part of the country, military personnel were being killed owing to their vehicles being blown up by landmines and IEDs. The Royal Thai Army had allocated 145 REVAs to these three provinces, of which three REVAs were assigned to my unit, Paramilitary 24, in Patani.

On 10 April 2013 at 21h13 my unit was tasked to intervene in an insurgent attack on a factory that produces Halaal food in the village of Thasu in the Pabare District. The three REVA armoured personnel carriers from 24 Paramilitary 24 Unit, being the closest to the factory, left immediately.

As the factory was under heavy incoming fire from the insurgents we had to proceed to the incident at high speed. The vehicle I was in had a crew of eight with a gunner in the front hatch and another in the rear hatch and I was in the lead vehicle of the convoy.

The dirt road to the factory, which was underfire from the insurgents, was very narrow with rice paddies on both side. The road was also not in good condition, so we could not drive as fast as we would have liked, having to proceed slowly and with care.

Approximately 300 metres from the factory we hit a landmine. It felt like the vehicle had gone through an undulation in the road. That is all I can recall of the impact. After the smoke and debris had cleared, we realised the vehicle was upside down

and that we had been involved in an IED attack.

The two remaining REVAs engaged the insurgents in a fire fight, who then fled fled from the scene into surrounding bush.

The investigation into the incident showed that the insurgents had used 2 x 50 kg gas containers as the explosive device. The explosion caused a 3-metre-deep and 5 x 5-metre-wide hole in the road while the REVA was flung by the explosion into the air landing some 30 metres away from the IED impact site!

If it wasn't for the superb design of the REVA vehicle we were travelling in, I do not think I would be alive to write this story today.

The sheer size and force of the IED destroyed the road and in the process lifted the REVA 30 metres away from the blast incident.

In a separate incident in southern Thailand in 2012 a 20 kg bomb was concealed in the tar road causing the REVA vehicle to lift in the air landing upside down 20 metres from the point of detonation. There were no fatalities. The vehicle was repaired and deployed back on operations ten days later!

Armoured recovery vehicles (ARV) play a vital role in recovering armoured personnel carriers which tend to be much heavier than their ‘soft-skinned’ counterparts while also being able to perform various infield repair tasks. The REVA VI armoured recovery vehicle was first launched at the Africa Aerospace and Defence (AAD) exhibition in September 2012. It is powered by a six-cylinder turbo diesel delivering 273 kW, giving the vehicle a top speed of 85 km/h and is equipped with a 26 ton recovery unit.

Armoured Recovery Vehicle
REVA VI

The crew of four can gain access through two front side doors or a rear door. It also has a rotating turret with an escape hatch. The REVA VI ARV was ICP’s first 6x6 vehicle.

SPECIFICATIONS

Crew:	2 + 2
Dimensions:	
Length	8 400 mm
Width	2 500 mm
Height	3 400 mm
Ground clearance	350 mm
Mass:	
TARA	18 970 kg
GVM	25 000 kg
GCM	48 000 kg
Performance:	
Maximum speed	85 km/h
Grade ability	50%
Angle of approach	30 %
Angle of departure	40°

Protection levels:

Ballistic – B7

Blast – STANAG 4569 level 4B

IED/EFP – 17.8 mm (8.9 mm armour protection plate with 8.9 mm secondary armour skin) on the sides.

Engine:

Maximum engine output 273 kW @ 2 200 rpm

Max torque – 1 590 Nm @ 12 00 – 1 500 rpm

Transmission:

Type – manual 10-speed

Transfer Box:

2-speed with inter axle diff lock.

Steering system:

Hydraulic power steering ZF8098

Axle:

Front axle – double reduction rigid steering axle.

Rear axle – double reduction rigid axle.

Suspension:

Semi elliptical steel suspension with telescopic dampers.

Brakes:

Service brakes – dual circuit air brake

Parking brake – spring brake on rear axle

Electrical System:

Voltage – 24-volt

Development on the Matador got underway in 2006 with the first prototypes being completed in 2007. The vehicle was displayed for the first time in 2007, during the International Defence Exhibition and Conference in Abu Dhabi. The first order for the Matador came from Azerbaijan for 25 of these vehicles, with them being manufactured in that country under licence from the Paramount Group. A second batch of 30 Matadors was delivered to the Azerbaijan Ministry of Defence in July 2014.

MATADOR

The vehicle is based on a 4x4 chassis powered with a choice of 224 to 300 hp diesel engines from MAN, Mercedes Benz or Cummins, with various transmission options such as ZF or Allison. To reduce life-cycle costs the Matador is designed around COTS. It is available in various configurations such as an armoured personnel carrier, armoured ambulance (accommodating two stretchers, two seated casualties and two combat medics), command vehicle, infantry fire support vehicle with remote-controlled weapons up to 14.5-mm calibre, and an antitank vehicle with a missile turret.

The Matador can accommodate a driver, codriver and 12 troops, who all gain access via a rear door or roof hatches, while built-in firing ports on the large armoured glass windows enable weapons to be fired from inside the vehicle.

The V-shaped double-skin monocoque welded steel hull provides a mine protection that exceeds level 4, the vehicle being capable of withstanding the blast of 21 kg TNT – under any wheel or a 14 kg TNT blast anywhere under the belly. Three large windows along both sides and one on each rear door ensure maximum situational awareness for the crew and troops.

SPECIFICATIONS

Crew:	2 + 12
Dimensions:	
Length	7 000 mm
Width	2 715 mm
Height	2 820 mm
Ground clearance	400 mm
Wheelbase	4 200 mm
Mass:	
Curb weight	11 000 kg to 13 400 kg
GVM	18 000 kg
Payload	5 000 kg
Performance:	
Top speed	120 km/h
Turning circle	20 m
Range	700 km
Angle of departure	41°
Angle of approach	34°

Protection Levels:

Ballistic – STANAG 4569 level 3
Blast – STANAG 4569 level 4

Engine:

6-cylinder turbo-diesel, 221 kW, 1 100 Nm.

Transmission:

Automatic
Transfer box various options

Brakes:

Air operated disc or drum brakes (ABS ready) on some models.

Electrical System:

Voltage – 24-volt

Slightly smaller than the Matador, the Marauder is available in two versions, the standard one hosting a two-man crew plus eight troops, and a stretched version seating up to ten troops. The Marauder features two side doors giving access to the driving compartment and a single door in the rear for the troops. The large windows provide excellent all-round visibility. The Marauder uses a power plant and drive-line system integrated with a 6-speed fully automatic transmission. The Marauder is based on COTS drive-line components.

MARAUDER

The double-skin monocoque hull structure affords good all-round protection and survivability to STANAG 4569 level 3 (equivalent to B7 protection level) for the crew compartment. The well-proven V-shaped hull can withstand the blast of a single anti-tank mine anywhere under the hull and a double anti-tank mine under any wheel (greater than STANAG 4569 level 3).

A number of variants can be customised to accommodate a light- and medium-calibre machine gun and cannon weapon installations, mortarfiring platforms, missile launchers and command, surveillance and control systems.

The Azerbaijani Armed Forces ordered 45 vehicles for delivery in 2012 and as with the Matador, they are assembled in-country using kits provided by Paramount.

Marauder is operated in a number of countries including Azerbaijan and the Republic of Congo.

SPECIFICATIONS

Crew:	2 + 8
Dimensions:	
Length	6 440 mm
Width	2 660 mm
Height	2 745 mm
Ground clearance	400 mm
Mass:	
GVM	18 000 kg
Payload	5 000 kg
Performance:	
Top speed	120 km/h
Turning circle	<18 m
Range	700 km

Protection Levels:

Ballistic – STANAG 4569 level 3
Blast – STANAG 4569 level 3

Engine:

Engine – 6-cylinder turbo-diesel
221 kW/300 hp @ 2 500 rpm, 1 100 Nm @ 1 200 – 1 800 rpm.

Transmission:

Automatic

Transfer Box:

Various options

Brakes:

Diff locks air operated front, centre and rear.

Brakes air operated disc or drum brakes (ABS ready) on some models.

Electrical system:

Voltage – 24-volt DC

MARAUDER

The Mbombe 4 is a new addition to the Paramount family following the acquisition of Industrial and Automotive Design. The vehicle has a front-mounted engine with the crew compartment behind it. The troops gain access via an outward-opening double door at the rear of the hull, while the driver and codriver have their own doors.

MBOMBE 4

The troop compartment has four bulletproof windows with firing ports below on both sides of the hull.

The Mbombe 4 is powered by a 450 hp six-cylinder diesel, giving it a top speed of 150 km/h and a cruising speed of 120 km/h with a range of 700 km.

The Mbombe 4 can withstand a 10 kg blast of TNT anywhere under the vehicle. It can be equipped with a state-of-the art, completely protected turret with a 12.7 mm machine gun mounting including day/night sights as well as four smoke grenade launchers.

SPECIFICATIONS

Crew:	2 + 2 + 6
Dimensions:	
Length	5 890 mm
Width	2 600 mm
Height	2 450 mm
Wheelbase	3 300 mm
Ground clearance	365 mm
Mass:	
Curb weight	13 000 kg
Payload	2 000 kg
GVM	15 000 kg
Performance:	
Top speed	150 km/hr
Turning circle	<18 m
Range	700 km
Angle of approach	45°
Angle of departure	47.5°

Protection Levels:

Ballistic – STANAG 4569 level 3
Blast – STANAG 4569 level 4a and 4b

Engine:

6-cylinder diesel, 450 hp
30 hp/ton @ 15 000 kg

Transmission: Automatic 6-speed

Transfer Box: 2-speed

Brakes: Pneumatic, disc, ABS standard

In 2012 Paramount purchased the Johannesburg-based Industrial and Automotive Design and has since taken over the manufacturing and marketing of the Gila 4x4 family of vehicles which is similar in size and appearance to the Casspir. The Gila, which was first developed

in 2005, has a steel V-shaped armour hull that can withstand a 14 kg TNT blast anywhere under the hull. Although the early models were powered by a Euro III Mercedes Benz engine, several other engine types can be fitted according to client specifications. The Gila can be fitted with a light turret on top of the vehicle behind the crew station, or, as seen in this photograph, with the Denel Dynamics remotely operated ALRRT turret (armed, long-range, reconnaissance turret) with the Ingwe missile.

THE GILA

There is also provision for a rear roof-mounted gun ring which can accommodate a 7.62 mm machine gun or 40 mm automatic grenade launcher.

The ten troops, driver and co-driver enter the vehicle via rear doors or roof hatches. Firing ports are provided for the troops on either side of the hull with observation windows. There are also two firing ports in the rear doors.

The Gila design allows for easy maintenance and repair. The engine, gearbox and cooling system are mounted on a rail which allows for the engine to be removed and replaced within an hour in field conditions. After-detonation costs are low and after-blast repairs can be done in the field. The Gila has a maximum combat weight of 13 600 kg with a payload of 3 000 kg.

The Gila APC and battlefield ambulance variants are in service with seven armed forces in Africa, a number of which went into service under the UN peacekeeping forces in Darfur, Sudan in 2009.

SPECIFICATIONS

Crew:	2 + 10
Dimensions:	
Length	6 390 mm
Width	2 500 mm
Height	2 750 mm
Ground clearance	400 mm
Wheelbase	3 800 mm
Mass:	
Curb weight	11 000 kg to 13000 kg
Payload	3 000 kg
Performance:	
Top speed	105 km/h
Turning circle	8 750 mm
Range	850 km
Protection Levels:	
Ballistic – STANAG 4569 level 3 Blast – STANAG 4569 level 4	
Engine:	

Engine 4-cylinder turbo-diesel (160 kW) (780 Nm).

Transmission – automatic
Transfer box – Allison

Brakes:

Diff locks air operated front, centre and rear.

Brakes airoperated disc, with ABS.

Manufactured by OTT Technologies outside Pretoria, the Puma M26-15 4x4 is a continuation and larger version of the Puma 4x2 mine-protected vehicle, which was successfully deployed in Iraq. It has a V-shaped monococque hull providing good protection levels against landmine and IEDs. The mine-protected vehicle has been designed and pitched as a value-for-money robust vehicle offering crew safety in Africa and other developing regions. The eight ton M26-15 can accommodate a driver, co-driver, eight soldiers and is capable of a road speed of 100 km/h. Wide windows ensure a good situational awareness while there are 12 shooting ports, two roof hatches and a 360° cupola with a pintle mount for a light machine gun.

PUMA M26-15 4x4

Entry is by two front doors or one rear door. In 2012 the Kenyan Army took delivery of 67 Puma M26-15 vehicles, which have seen action on peacekeeping deployments in Somalia.

SPECIFICATIONS

Crew:	2 + 8
Dimensions:	
Length	5 810 mm
Width	2 265 mm
Height	2 710 mm
Ground clearance	300 mm
Mass:	
Tare	7 200 kg
GVM	8130 kg
Pay load	930 kg
Performance:	
Top speed	100 km
Range	800 km
Gradient ability	60%

Protection levels:

Ballistic – B6

Blast – 7 kg TNT under the hull, 14 kg TNT under any wheel.

Engine:

Type – Cu nimins B5.9 – 155-30
Configuration – 6-cylinder in line turbo
Maximum power – 115 kW (155 hp) @ 2 500 rpm

Maximum torque – 590 Nm @ 1 500 rpm

Transmission:

Type – G 600 synchromesh
Number of gears – 6 forward, 1 reverse.

Transfer Box:

Type – 2-speed selectable 4x4

Steering system:

Type – hydraulic power assisted

Suspension:

Springs – semi-elliptic leaf springs
Shock absorbers – double telescopic hydraulic.

Brakes:

Service brakes – dual air system.

Park brakes – spring operated in both axles.

Auxiliary brake – engine exhaust brake.

OTT Technologies launched the Puma M36 Mk5 medium mine-protected vehicle in 2012. The M36 traces its origins back to the OTT Puma M26 MPV and even further back to the venerable South African Mamba MPVs. The 14 ton GVM M36 uses the Ashok Leyland Stallion 4x4 automotive components, ensuring easy and economic after-sales support.

PUMA M36

It carries a crew of up to 12 including the driver, while the V-shaped monocoque hull protects the crew against mines, IEDs and machine gun fire. The M36 can be used as an armoured personnel carrier, command and control vehicle, ambulance or in an IED-clearing role. The interior can easily be reconfigured by replacing any number of the individually mounted seats with purpose-designed modules such as additional radio racks, command and control modules or ambulance equipment.

SPECIFICATIONS

Crew:	2 + 10
Dimensions:	
Length	6 643 mm
Width	2 551 mm
Height	2 767 mm
Ground clearance	300 mm
Mass:	
Tare	11 000 kg
GVM	14 000 kg
Performance:	

Top speed	100 km/h
Range	800 km
Gradient ability	60%

Engine:

Type – HA 57L 165

Configuration – 6-cylinder inline turbo inter cooler

Maximum power – 655 kW (220 hp) @ 2 500 rpm

Maximum torque – 800 Nm @ 14 000 – 19 000 rpm

Transmission:

Type – ZF 65850 GB synchromesh
Number of gears – 6 forward, 1 reverse.

Transfer box:

Type – 2-speed – 4x4

Steering system:

Type – hydraulic power assisted

Suspension:

Springs – semi elliptic leaf springs
Shock absorbers – double telescopic hydraulic

Brakes:

Service brakes – dual air system
Park brakes – spring double air release auxiliary brake – engine exhaust brake interlinked with service brake.

CASSPIR NG 2000

More than three decades after the first Casspir rolled off the production line in 1979, a New Generation 2000 Casspir was launched by Denel Mechem in April 2013.

While the NG 2000 series of vehicles all retain the same basic features of the original Casspir, Denel Mechem have upgraded the hull protection by using a higher quality of steel, increased its power, improved the accessibility for passengers and mounted it on more versatile and reliable vehicle platforms.

The NG 2000 design also features side doors for the driver and crew and an improved back-door design for troops to gain access into the vehicle. The engine and drive train have been designed to accept a number of popular, internationally available drive-trains, making the vehicle a more cost-effective solution for its users in terms of maintenance costs, spare parts and logistics.

The standard Casspir NG 2000 is equipped with a 320 hp Mercedes Benz Zetros drive train, while the NG 2000 A with a 230 hp Mercedes Benz AXOR and the NG 2000 B equipped with a 290 hp North Benz Chinese Power star drive train. There are plans to develop a NG 2000 C with a 280 hp Tata drive-train and a NG 2000 D – based on loose components of either a Cummins or Cat engine, equipped with an automatic transmission and Axle Tech axles.

Various Casspir NG 2000 variants are available, including cargo, water, fuel, command and control, infantry fighting, recovery and a field ambulance. All variants are available in 6x6 or 4x4 formats and with a choice of manual or automatic transmission.

The vehicle has a cruising speed of 100 km/h on roads and up to 40 km/h on most offroad conditions with a range of up to 800 km on a standard fuel tank. It is designed to withstand the blast of a 14 kg explosive anywhere under the hull and 21 kg under any wheel.

The United Nations and Angola were the launch customers in July 2014for the wide-body ambulance. The United Nations will use the vehicles as part of the Amisom hybrid African Union and UN mission to Somalia.

SPECIFICATIONS

Crew:	2 + 10
Dimensions:	
Length	7 756 mm
Width	2 733 mm
Height	2 903 mm
Wheel base	4 200 mm
Ground clearance	350 mm
Mass:	
GVM	14 300 kg
Performance:	
Speed	110 km/h
Gradient ability	60%
Range-on road	800 Km
off road	600 km
Turning radius	16 m
Angle of approach	33’
Angle of departure	50”
Protection levels:	
Ballistic – B6 7.62 mm x 51	

Blast – 14 kg anywhere under the hull, 21 kg under any wheel.

Engine, transmission and transfer case

They are available in different options as described in text body above.

Suspension and axles vary according to each different drive chain.

Brakes:

Service – dual circuit full-air, drums allround.

Emergency parking – spring brakes on rear wheels.

Auxiliary – remote mounted engine exhaust brake.

The Hornet 4x4 Rapid Deployment Reconnaissance Vehicle is the standard reconnaissance vehicle of the South African Special Forces. The Hornet, originally developed by BAE Land Systems South Africa OMC as the Wasp, underwent competitive evaluation between November 2001 and June 2002, including rigorous user, technical and durability tests. A prototype was delivered in March 2004 and underwent further user evaluation. Through Project Ambition 1 A, 25 Hornets were delivered in August 2006.

Rapid Deployment Reconnaissance Vehicle
HORNET

The vehicle is constructed of a space frame rearward of the firewall and a tubular chassis forward of the firewall.

The Hornet's standard configuration comprises three front seats for driver, gunner and commander. The troop carrier configuration can carry eight. Depending on the specific application, six different rear platforms can be fitted, enabling the same vehicle to be used for a variety of tasks, such as reconnaissance, fire support, troop carrier, light strike actions, weapons deployment and casualty evacuation. It also has a fold-out cargo compartment which is on the back of the vehicle.

The Hornet is protected against anti-personnel mines. Frontal ballistic protection is provided against 7.62x51 mm ball for the crew up to bonnet height, including the armoured glass and the sides for the engine. Four can fit into a C-130 Hercules.

SPECIFICATIONS

Dimensions:	
length	3 150 mm
width	1 864 mm
height	2 165 mm
Angle of approach	63°
Angle of departure	90°
Ground clearance	243 mm
Wheel base	2 200 mm
Wheel track	1 620 mm

Chapter 7

SOUTH AFRICAN ARMOURED CARS AND INFANTRY COMBAT VEHICLES

The South African Army has long leaned to armoured cars, for reconnaissance, and as combat vehicles. This is a result of being a small army in a large theatre, which demands good operational mobility and the ability to cover considerable distances without transporters or railways. Tracked vehicles do not meet this requirement. Added to this fundamental operational consideration, the Army had done well with the quite primitive armoured cars that it used in East and North Africa in World War II, where they proved invaluable for reconnaissance and screening and, in East Africa, also as mobile and protected firepower to support dismounted infantry. The Italian Army auxiliaries dubbed them Rhinoceros for their ability to batter through bush and their lethal reputation against infantry.

The Army's first modern armoured car was the Panhard AML, which was further developed in South Africa to become the Eland, and was successful in a range of roles, including direct combat with tanks – not envisaged by its designers. It was, however, very limited in mobility and ballistic protection, had no mine protection at all, and its 90 mm low-pressure gun also had real limitations. Some armoured car units changed over to the Ratel-90 in the 1980s, which provided better mobility, greater ammunition stowage and a more crew-friendly interior. But the real solution was the eight-wheeled Rooikat, which provided outstanding operational and tactical mobility, good protection and a high-velocity 76 mm gun that could deal with any tanks it was likely to encounter.

The Ratel was the first true wheeled Infantry Combat Vehicle (ICV) to enter military service worldwide and was generally regarded as an influential design. For its time the Ratel was one of the best armoured wheeled fighting vehicles to be found anywhere in the world.

RATEL

Design work began in 1968 until the prototype was delivered to the SADF in July 1974 and the first production vehicles in 1976. It was to become the backbone of the South African Army's mechanised infantry units, seeing heavy action in operations in southern Angola during the 26-year-long Border War. Its long legacy has ensured a place in the South African Army lore, though, after 40 years of service, the Ratel was eventually replaced in 2014 by the Finnish Patria family of 8x8 wheeled armoured vehicles, designated locally as the Badger.

The Ratel was developed in South Africa, at a time when the UN-led international arms embargo was at its height against the country. The monocoque Ratel hulls were mass

produced in Sandock Austral's Durban dockyard and taken by rail to Boksburg for fitting out. The vehicle was initially referred to as the 'Springfield Büssing Buffel'after the local (East Rand) company where it was developed.

Developed for the South Africans Army's unique style of operations, focused on the mobile warfare concept developed in the late 1960s and the beginning of the 1970s, and for the demands of the southern Africa theatre (not least low force densities that required forces to move great distances quickly), the Ratel was a pioneer vehicle in several respects. It was the first ICV of any type to have a proper commander's cupola offering a full 360° field of view. It was also the first to enter service with a dual-feed cannon, which enabled the gunner to rapidly select either armour-piercing or high-explosive ammunition as required. It should be remembered that the requirement for an ICV evolved directly from the SA Army's commitment to mobile warfare; and not as a result of, or even for, the so-called Border War.

Given the need for highly mobile operations across vast distances in rough crosscountry driving conditions, the South Africans opted for a 6x6 wheeled vehicle rather than tracked. A wheeled ICV was also considered more reliable, requiring less maintenance operating in these types of conditions. It had on-board potable water storage tanks, essential for the troops operating in semi-arid conditions. It also had high on-board ammunition capacity, a l

lowing for extended operations with little logistic support, and a road range of 1 000 km, unequalled at the time.

Six infantrymen sat back-to-back in the main troop compartment, allowing them to see out of the vehicle and use their personal weapons for close-in protection from the four firing ports on each side of the vehicle, with two more seats available in the ‘tunnel’ next to the engine. The infantry section leader sat on the left of the turret where he could see through the driver’s windows. The driver sat in the centre of the vehicle and the anti-aircraft gunner was to be be more accurate at the back next to the engine. The section commander’s normal position was in the turret as vehicle commander; he would move to the ‘jump seat’ immediately prior to dismounting on or near the objective.

The driver had excellent forward visibility through three large bulletproof windows to thefrontand sides. During combat these could be quickly covered by armoured shutters hinged at the bottom and activated by the driver with a single handle from within the vehicle. With the shutters in position the driver observed the terrain through three day periscopes, one to the front and one either side. Above the driver’s position was a singlepiece hatch cover that opened to the left. The driver’s seat and steering wheel were adjustable allowing him to enter his compartment from the rear, so enabling drivers to be changed without either of them leaving the vehicle.

The Ratel also had multiple doors and hatches: two hinged rectangular main pneumatically operated doors located on the vehicle's sides, a rectangular rear door and four outward-opening roof hatches allowed the crew to exit the vehicle from many directions at once, or to easily dismount under cover during an ambush.

The all-welded steel-armour monococque hull of the Ratel provided all-round body protection against 7.62 mm fire, with protection over the frontal arc against 12.7 mm armour-piercing rounds. The sides were slightly sloped to improve basic ballistic protection. The Ratel also offered a good protection against anti-tank mines and was in general able to be quickly repaired in the field after a mine blast.

The engine compartment was at the rear left side of the Ratel with access panels in the roof for ease of maintenance.

Power for the Ratel was supplied by the Büssing D 3256 BTXF six-cylinder direct-injection turbocharged diesel coupled to a fully automatic powershift gearbox with a hydrodynamic torque converter. The gearbox could also be operated manually and had a mechanical emergency gearshift. Power was transmitted to the three axles in two stages with final reduction by means of planetary gearing housed in the wheel hubs. The three axles were provided with their own lockable differential and longitudinal differential locks.

Suspension consisted of progressively acting coil springs and large hydraulic shock-absorbers. The hydropneumatic braking system could be assisted by an exhaust brake provided through the engine. The powerpack was designed for easy in-field maintenance and could be removed from the vehicle by two men with a crane in less than 30 minutes. Quick disconnect couplings and connectors were provided in all power, hydraulic, electric and pneumatic circuits.

The main variant was the Ratel-20, armed with a French GIAT 20-mm cannon in a two-man turret, plus three 7.62 mm MGs, one coaxial, one over the turret and one on a pintle mounting over a hatch in the rear hull roof. The 20-mm cannon had an effective range of 2 000 m. Although the cannon was derived from the French version, that fitted to the Ratel was manufactured locally by LIW (now Denel Land Systems), the F1 (later F2) version.

R 56202
AFC 732 T

Afire-support variant, the Ratel-90, was virtually identical to the Ratel-20 apart from the two-man turret mounting a 90 mm gun and one passenger less to make room for the bulkier ammunition. It was fitted with a complete turret originally from the Eland-90 armoured car.

While not inherently designed to counter anti-armour threats, on occasions during the Border War when Ratels encountered enemy armour, such as the Soviet-made T-55 and T-62 tanks in Operations Protea (1981), Askari (1983) and Modular, Hooper and Packer 1987/1988, they achieved successes through skilful manoeuvring and only at very short ranges. The 61 and 62 Mechanised Infantry Battalion Groups found that each enemy Soviet tank required multiple shots from their 90 mm guns to disable them, and that the Ratels had to attack in groups, fire from point-blank range, and hit the tanks in the engine vents, turret rim or similar weak points in order to have an effect.

Representing a complete range of armoured 6x6 wheeled vehicles, the Ratel was a rugged ICV broadly adopted to specific battlefield roles with ten variations being developed: command, fire support vehicles (with 90 mm gun turrets), mortar vehicles (with 60 mm breechloading mortar turrets), and, later, tank destroyers armed with the ZT3 laser-guided, 5 000 m-range anti-tank missiles, mortar carriers with 81 mm muzzle-loading mortars carried in what had been the troop compartment and an 8x8 Ratel logistics vehicle, which did not go into production.

When production finally ended in 1987 approximately 1 400 Ratels had been manufactured for local use and export. The Ratel is in service with Jordan, Libya, Morocco, Rwanda, Senegal and Yemen.

Ratel is the Afrikaans word for the native honey badger, a fierce, hair-covered carnivore, which uses its agility and imposing claws to good effect.

SPECIFICATIONS

Number of drive wheels:	6
Number of wheels:	6
Dimensions	
Length	7112mm
Height	2915 mm
Width	2 516 mm
Ground clearance	340 mm
Wheelbase	2 809 mm
Trench	1 150 mm
Vertical obstacle	350 mm
Fording depth	1 200 mm
Engine:	
Engine power output – 282 hp	

Engine type:	
D 3256 BTXF 6-cylinder in-line turbocharged diesel 282 hp, 210 kW.	
Top road speed:	105 km/h
Operational range:	1 000 km
Weight:	19 tons

R 56121

RATEL VARIANTS

The first production models were designated the Mk I and were followed in 1979 by the Mk II, final deliveries of which were made in early 1987. The differences were mainly the result of operational experience in Namibia and long-range operations into southern Angola. There were very few so-called Mk Is built (approximately 13) so that virtually all of the production vehicles were in effect Mk IIs (although not specifically designated as such).

Most of the modifications were subsequently retrofitted to earlier vehicles when they returned for servicing.

The Ratel Mk III upgrading programme commenced in 1985 and mainly included the following modifications to the vehicle: an improved cooling system, better bush protection, an automatic cocking system for the 20 mm G12 cannon built by Denel Land Systems, and in general, a range of smaller functional modifications to the vehicle.

Ratel-20

The standard combat vehicle of the mechanised infantry battalions, the Ratel-20 was armed with a duel-feed 20 mm F2 cannon (M693 quick-firing cannon), and a co-axial 7.62 mm machine gun in a two-man turret and a 7.62 mm machine gun in an anti-aircraft ring mounting at the rear right of the vehicle. Turret traverse and weapon elevation were manual. The weapons had an elevation of+38° and a depression of-8°. The 20 mm cannon fired armour-piercing (effective range 1 000 m), high-explosive (effective range 2 000 m) and practice (effective range 1 000 m) projectiles. The Ratel-20 had a crew of three and nine infantry. In operations the Ratel-20 proved to be a very useful ICV with a good blend of firepower, protection and mobility, coupled with sufficient comfort which allowed the mobility to be exploited.

Ratel-90

The Ratel-90 was a fire-support and anti-tank vehicle derived from the Ratel-20 for service with the antitank platoons of the mechanised infantry battalions, and later replaced the Eland-90 in some armoured car regiments. It was designed in response to the need for a vehicle capable of keeping up cross-country with the highly mobile Ratels which the smaller Elands sometimes found difficult to do. Modifying the Ratel to take the new Eland-90 turret resulted in a changed roof line, with only two roof hatches above the main troop compartment. Inside, the troop compartment was partly replaced by additional ammunition racks. This was reversible at unit level, allowing for the vehicle to be configured virtually on a case-by-case basis. It is a little-known fact that a 90 mm version was part of the original specifications.

A Ratel-90 forms part of a laager in southern Angola, allowing the crew to take a break in between operations during the 1987 campaign.

Ratel-60

The Ratel-60 was used mainly by the support troops of the armoured car squadrons, most often deployed as one per armoured car troop to give close reconnaissance and protection as well as some assault pioneer capability. It was also used in other roles. It had a crew of 11 consisting of a vehicle commander, driver, main gunner, anti-aircraft gunner, section commander and six infantrymen. It was fitted with a two-man turret armed with a 60 mm M2 breech-loading mortar and 7.62 mm coaxial machine gun. An additional 7.62 mm anti-aircraft machine gun was mounted at the rear of the vehicle on the right side. The 60 mm mortar was capable of firing HE, smoke and illuminating bombs to a maximum range of 1 500 m.

The Ratel-60 was first fitted with the turret of the Eland-60, later with a modified command turret armed with a 60 mm mortar and a 12.7 mm machine gun.

Ratel Command

The Ratel Command differed from the Ratel-20 in that it had a new roomier turret armed with a 12.7 mm and a co-axial 7.62 mm machine gun, with a 7.62 mm machine gun mounted at the rear right hull as on other members of the Ratel family. The Command vehicle had seating for nine: the vehicle commander, driver, main gunner and six command post personnel. The internal fittings included map tables and communications equipment optimised to suit the role of the particular vehicle. All the Command Ratels were fitted with air-conditioning systems to cope with the additional heat generated by their equipment. The Ratel Command was also employed as an artillery command vehicle.

A Ratel Command on the Gerotek vertical step test platform.

Ratel-81

The Ratel-81 was essentially a turret-less Ratel with an 81 mm mortar installed in the fighting compartment, and a new commander's cupola between this and the driver. The 81 mm mortar was mounted on a turntable that could be quickly traversed through a full 360°. It fired through a two-part circular roof hatch which opened front and rear. The Ratel-81 allowed the mortar teams to move in and out of action far more quickly than was possible with ground-fired mortars. The mortar could be dismounted for ground use, and the vehicle carried a standard load of 148 bombs, although crews often squeezed in more ammunition. The Ratel-81 mm had a crew of six including the driver. This version had only two firing

ports and associated vision blocks, one on either side.

Ratel-120

This Ratel prototype fitted with a 120 mm mortar system was shown for the first time in 1994. Mounted in the rear of the Ratel was a Denel Land Systems 120 mm muzzle-loaded mortar which was used in conjunction with a computer weapon aiming system that could rapidly process data (type of mortar bomb, charge, environmental conditions and target location) in conjunction with a land navigation system to enable targets to be quickly engaged. The 120 mm mortar was mounted on a turntable that could be traversed through 360°. The Ratel 120 mm self-propelled mortar carrier could carry a total of 46 mortar bombs with the normal load consisting of 28 standard and 18 rocket-assisted 120 mm mortar bombs. There was no immediate need by the South African Army for this Ratel 120 mm mortar carrier which never went into production or service. The Ratel 120 mm mortar carrier had also never been a direct requirement of the Ratel project.

Ratel-ZT3

The ZT3 was developed as a much-needed potent anti-tank guided missile system capable of engaging modern MBTs that the South Africans encountered during operations in southern Angola. Under Project Raleigh, the Ingwe missile and associated launch systems were developed in the 1980s as a long-range indigenous anti-tank guided missile. This entered service, mounted in a triple launcher atop a modified Ratel-60 turret, and was known as the ZT3 Swift. The next generation, which changed from a laser command link to laser beam-riding, was called the Ingwe, which also had a 1 000 m greater range. The ZT3 Swift used a laser command link in place of a wire link that could break in bush, and had a range of 4 000 m; the later Ingwe is a laser beam-rider with a range of 5 000 m. The Ingwe automatically determines its own position in the laser beam and manoeuvres onto the line of sight (LOS). The missile follows the LOS until the target is hit. The Ingwe also has a tandem warhead that enables it to penetrate steel armour protected by explosive reactive armour tiles, and alternative warheads are being developed for use against other targets, for instance bunkers. The Ratel-ZT3 carries an additional 12 missiles inside for manual reloading. This variant first saw combat during the September 1987 Lomba River battles of Operation Moduler when four pre-production ZT3 anti-tank guided Ratel systems were deployed with 32 Battalion: one of these pre-production Ratels destroyed three Soviet tanks at ranges over 2 000 m within ten minutes. A total of 53 Ratel-ZT3s were supplied to the South African Army. The Ratel-ZT3 turret, as shown below, was converted from the Ratel-60 turret to take the missiles and fire control system.

R 37374

Ratel Logistic

This eight-wheeled ‘Ratel Log’, as shown below, was an armoured logistic support vehicle developed specifically to support the mechanised infantry and armoured car units. In its basic configuration the ‘Ratel Log’ was able to carry all the stores needed by mechanised infantry platoons operating for a week under normal conditions or up to two weeks over ranges of around 2 000 km under low-intensity conditions. The payload often tons would normally consist of six 1.2x1.2 metre containers, three spare wheelsand a small generator on its load bed. It also had a refrigerator, a freezer with 500 litres of fresh water and was fitted with a hot water shower. Integral fuel tanks in the hull could hold 2 000 litres of diesel. A hydraulically powered fuel pump could fill the internal bunker from an external supply or fill two vehicles simultaneously, one on each side, and could pump from one extended bunker to another. Hand pumps were fitted in case of a power failure. The ‘Ratel Log’ was capable of a maximum speed of 86 km/h on the open road. It had a fuel capacity of 560 litres with a maximum range of 700 km on road or 14 hours of cross-country driving. Only two prototypes were produced, as the SA Army opted not to deploy such a specialised armoured cargo vehicle, preferring to rather use the cheaper SAMIL-100 Kwêvoël mine-protected truck, the standard flatbed fitted with bins similar in concept to the Ratel Log, and the diesel bowser for fuel.

Ratel EAOS – Enhanced Artillery Observation System

The Ratel EAOS forms a key part of the AS-2000 artillery engagement system. It was a rebuild of an existing Ratel with its turret removed and a raised superstructure added behind the driver’s position. The primary feature of the Ratel EAOS is its hydraulically operated mast, which raises a sensor package up to 30 metres above intervening terrain without exposing the vehicle itself. The sensor package consists of a video camera (day or night operable), a long-range zoom lens, an infra-red system for night operations, a laser designator, and a laser rangefinder with a video channel. This system provides accurate observation during the day to 20 km and at night to 3.5 km. In the vehicle itself is a mounted computer system to manage the data and to provide firing solutions, an integrated vehicle inertial land navigation system (later replaced by GPS), and a pointing control. Extra radios to transmit new target locations to artillery and mortar batteries are provided. The vehicle has a five-man crew consisting of the forward observation officer, technical assistant, two signallers and a driver. Around ten of these Ratel EAOSs were manufactured until the project was abandoned as being too expensive.

A
B
C
D
E
F
G
H
I
J
K
L
M
N
22

KEY DESIGN FEATURES OF THE RATEL

A. **Two-man turrets** are fitted to all Ratels. The commander on the left of the turret and gunner on the right. The commander's cupola has bulletproof viewing ports allowing for good allround observation.

B. **Main armament** of the Ratel-20, is a French GIAT 20-mm quick-firing cannon in a two-man turret. The Ratel-90, shown here, is the fire support version, armed with the same low-pressure 90 mm gun as the Eland-90 armoured car.

C. **The driver's station** offers excellent visibility through three large bulletproof windows. In times of heavy fighting, these can easily be covered by drop-down steel shutters at the touch of a single lever within the vehicle and revert to use of a periscope. Drivers can change without anyone having to get out, as the driver's station is open to the rest of the vehicle.

D. **Monocoque armoured steel hull** provides protection against landmines. The front armour provides protection against 12.7 mm rounds, while all-round protection is against 7.62 mm.

E. **6x6 wheeled configuration.** For decades South Africa was involved in conflicts where their forces had to travel great distances with little logistical support in harsh rough conditions. The Ratel's 6x6 wheeled configuration is perfect for such prolonged journeys. If necessary the Ratel can travel with two missing wheels on the rear axles.

F. **Sidedoors.** On either side of the hull behind the driver's position is a rectangular door opened pneumatically by the driver.

G. **Infantry compartment**. The section leader sits next to the turret with a view through the driver's windows, six infantrymen sit back-to-back in the main part of the troop compartment, two in the'tunnel' next to the engine, and an 'antiair gunner' just forward of the back door, with a machine gun on a ring mounting at his hatch.

H. **Standard equipment** includes a complete set of tools, spades, picks, shovels and axes, a tow bar and towing cables, a first aid kit, two petrol stoves, fire extinguishers, emergency spares, two 50 litre drinking water tanks, two external stowage boxes, radios, an intercom and a remote handset and a 1 000 m of cable.

I. **Firing ports**. There are four vision and firing ports on both sides of the Ratel.

J. **Rear door.** At rear right of hull.

K. **Powertrain.** The Ratel is powered by a Büssing D 3256 BTXF 6-cylinder in-line turbo-charged diesel engine developing 282 horsepower. It is fitted into a compartment at the left rear of the vehicle with access panels in the roof for maintenance. For ease of maintenance in the field away from base workshops, the power pack is designed to be removed from the vehicle by two men with a crane in less than 30 minutes.

L. **Rear machine gun mount.** On the right rear of the roof the Ratel is fitted with a circular mounting and hatch cover for a 7.62 mm machine gun.

M. **Roof hatches.** There are four hinged hatches above the troop compartment. These can be opened all the way, i.e. flat or locked open at 90° providing welcome ventilation or to give

protection while fighting ‘heads out’.

N. **81 mm grenade smoke** dischargers. Two are fitted on both sides of the Ratel which are useful for covering an advance or screening a retreat.

The *iKlwa*, Zulu for stabbing spear, an upgraded Ratel, was revealed by BAE Land Systems South Africa in September 2006, partly with an eye to the Ratel replacement requirement. The engine was moved forward to the left side just behind the driver, and a hydraulically operated rear ramp added to the crew compartment.

IKLWA

For this upgrade a new power pack consisting of a Cummins ISL 336 kW diesel coupled to the Renk HCV106 transmission was developed and installed, the left-hand door now serving as a power pack access hatch.

The driver's central position at the front of the hull was retained but improved to include a new wraparound instrument panel.

The number of infantry carried can be up to 13 with each of these being provided with a new seat suspended from the vehicle roof to reduce the risk of foot and lower leg injuries from sudden upward acceleration of the floor in a mine blast. The upgraded Ratel iKlwa has an unloaded weight of 14.5 tons and a maximum gross vehicle weight of 23.5 tons, and a top road speed of 110 km/h.

The first prototype was armed with a 12.7 mm MG South African RDL Rogue overhead weapon station. The iklwa went to a Mk III variant with minor modifications to the rear hull

and a 30 mm Tactical Remote Turret (TRT) which carried a Russian 2A42 cannon. The TRT has the advantage of being remotely controlled, taking up less space inside the vehicle as there is no need for a rotating turret basket.

In 2007 Denel Land Systems was awarded the contract for 264 Badger (8x8) Mechanised Combat Vehicles (MCV) for the SANDF. Thus the locally developed iklwa never went into production, bringing an end to any extended lifespan the legendary Ratel may have had in the SA Army . The iklwa could still go into production for export on the basis of the phased-out Ratels.

Commandant Johann Dippenaar was the commander of 61 Mechanised Battalion Group (61 Mech Bn Gp), Ratels being the main fighting vehicle of the combat group. On one particular search and destroy operation in southern Angola, the Ratel that Commandant Dippenaar was travelling in on 11 June 1980 hit a mine. He takes up the story…

I survived the ride

It's important that the reader has some insight into our training for external operations. Force preparation at 61 Mech Bn Gp, focused on all aspects that would ensure a constant combat readiness force. Aspects that were different in the SWA/Angola theatre were rehearsed often: command, control and radio communications with forces spread over a large, mostly featureless savannah-type terrain. Immediate action drills for mine-clearing and antiaircraft drills were high on the training programme. For instance, on receiving the code-word 'Mine, Mine' all vehicles would stop, take up all-round defence and a mine-clearing plan would be executed. Soldiers would only step in vehicle tracks. On the code-word 'Arend, Arend' ('Eagle, Eagle') the Ratels travelling in line astern would immediately peel off to the left and right alternately, drive into the bush, stop under a suitable tree and deploy the camouflage net strapped to the spare wheel on the rear of the hull. The soviet MiGs were always a danger to our ground forces, so we had to be on constant alert.

Sand-modeling was used to great effect to rehearse tactical plans by sub-unit commanders. They had to present a chronological account of their immediate actions for different scenarios. This turned out to be very successful in preparation for operations and especially for control during the fighting, it built valuable confidence in junior leader behaviour under stressful situations – especially in respect of complicated operations such as obstacle-crossings.

By early 1980 our intelligence reported that a SWAPO headquarters had been located at Chifufa named QFL. In June 1980, 61 Mech Bn Gp was tasked to destroy QFL, the enemy headquarters, about 150 km into southern Angola. The enemy was dug in at a number of complexes over 27 square kilometres. On D-Day there was fierce fighting with one Ratel shot out and another badly damaged. That afternoon the combat group moved out of the target area to laager south of the objective for safety. When on the move the force drove through an enemy ambush. All hell broke loose around us, and we realised we had ridden into an ambush. The convoy was hit by heavy fire from both flanks – it had unwittingly ventured into a carefully prepared L-shaped ambush, manned by an estimated 50 to 80 heavily armed insurgents, which was not sprung till the slow-moving main body was squarely in the killing zone.

A Ratel after detonating a landmine.

It came as a dreadful surprise. One can assume that many of the bone-weary and very dirty troops had begun unwinding slightly for the first time in many hours after intense fighting, standing up in their hatches or even climbing out on to the hulls to enjoy some fresh air before it got too cold. Suddenly they found themselves under fire from rifles, light machine guns, 82 mm mortars, RPG-7s and even a 57 mm recoilless gun. According to my gunner the insurgents were 'in the trees, they were on the ground, they were everywhere. They sat with RPGs in the trees…you could see an RPG [missile] or a tracer [bullet] coming.'

I was standing up in the turret when the attack began: the tracers were flying millimetres above our heads, and one of my crew hauled me back into the vehicle. Yet in spite of the very real and immediate danger, one could not help noticing that a strange nonchalance seemed to fill many of the infantrymen as they fired back at the ambushers with all their weapons.

I mean, at that stage we were feeling nothing. They hit my Ratel with an RPG; fortunately not exploding. Incredibly, the convoy had suffered no casualties to speak of, with the exception of the one platoon. Even they did not realise in what peril the convoy had been till they examined the abandoned position the next day. The ambush had been well laid out and sprung at exactly the right moment; one of the soldiers reported in his diary on Operation Smokeshell. that only "a miracle from the Higher Hand" had saved them all.

The next morning the convoy was bundu-bashing back in line astern along the same dry riverbed in which it had been ambushed the night before, led by Combat Team 20. My Ratel Zero was three vehicles down the line, with me standing in the turret and General Viljoen, the Chief of the SA Army, in the vacant tail gunner's hatch at the rear.

An inspection reveals no damage to the h ull after detonating a landmine.

When the front vehicles reached the inner angle of the 'L' they eyed it with some suspicion, since it was the perfect place for yet another am bush. They reported their misgivings to me. I ordered them to a halt and instructed the troops to debus and reconnoitre – at this time I was looking for suitable areas to allocate for the mopping-up operation to start.

My crew alerted me to some one-man trenches about 50 metres away on the right (or eastern) flank, and I decided to use the waiting time to take a closer look. I ordered the driver to turn out of the convoy and to move closer to the open trenches. At this spot the terrain was open, barring a tree or two, and one could clearly see the trenches and RPG-7 rockets, which had been left behind.

I took a long look, with Viljoen standing up in his hatch, trying to see past the turret. I then told the driver to turn back to the convoy. Viljoen says that he hears me saying, "Turn left," and then repeat the command in a slightly sharper tone. Suspecting that I had seen something untoward, he bent down to pick up his R4 rifle, which lay at his feet, and then as he came erect the Ratel's right front wheel went over the triple detonators of the TMA-3, where it lay hidden in the sand.

The mines had been carefully placed on top of another for added effect, and immediately both went off. A platoon commander, who was climbing out of his Ratel at the time, remembers: "I heard this big explosion. It was completely deafening. I'd never heard anything like it in my life. BOOM! A great cloud of dust, and the Ratel's wheel-rim… shot up out of the dust-cloud. I knew immediately it was a mine… my first thought was that the whole Ratel HQ had been blown to bits."

The double explosion flung the Ratel at least two metres into the air, propelling Viljoen out of his hatch. Viljoen came down on the adjacent engine-gratings with what must have been a bone-jarring thump, but recovered quickly. Under the impression that the Ratel had been hit by an RPG-7 rocket, he jumped off and took cover with his R4 rifle.

My fear was that the Ratel might catch fire. I helped the driver, Rifleman J.J. Eloff, to get out. Fortunately Eloff had been wearing his safety harness (this was SOP for combat vehicle occupants) and was remarkably unhurt, although his station was almost on top of the right front wheel.

The incident was a species of left-handed tribute to the design and strength of the Ratel. The TMA-3 is an anti-tank mine

designed to disable or destroy a 50 ton main battle tank, while the Ratel was a lightly armoured infantry fighting vehicle weighing a mere 18 tons or so. In spite of this it suffered so little damage – a mangled front axle and some disruption of the gearbox – that once the axle had been replaced it was in sufficiently good running order to be sent back under its own steam. It did not catch fire, no fragments penetrated the hull and none of the occupants suffered physical injuries, although the crew all required treatment for shock.

As commander I transferred from my now damaged HQ Ratel to the Gunner's Ratel, call sign 49, and returned to take control. In addition to everything else, radio reception in the area was poor, so that at this stage I had difficulty in communicating with the air component, and could not reach the tactical headquarters at all. Viljoen, meanwhile, resumed his prowling, apparently none the worse for having been levitated by the mine, and shrugged off an anxious inquiry about his wellbeing which later arrived from Brigadier Badenhorst, the operational commander, when communications improved.

It was an impressive performance which did not go unnoticed among the soldiers, but if Viljoen realised this, he paid it no heed and certainly did not indulge in any grandstanding. Dramatics and personality cults were not his style at all.

Strangely, I remember, just after the explosion, while the vehicle must still have been in motion from the explosion I heard: 'All stations, this is Golf Four Nine, Zero has detonated a mine…"after which my radio made a whistling sound and cut out.

The Ratels form a laager in southern Angola with a Ratel-90 in the foreground.

A Soviet tank destroyed by Ratels in southern Angola burns away.

On 4 August 1987 the SADF launched Operation Modular, to prevent the FAPLA advance on UNITA-controlled Mavinga. After an extensive build-up FAPLAs 16, 21 (both light infantry), 47 (armoured) and 59 (mechanised) brigades – about 6 000 men, 80 tanks, ICVs and artillery – moved from Cuito Cuanavale to cross the Lomba River and attack Mavinga. They received air support from Menongue and Cuito Cuanavale, including MiG-23s flying ground attacks.

The first SADF unit to deploy was the light infantry 32 Battalion, with some Ratel-90s and the first four missile-armed Ratel ZT3 tank destroyers, followed by 61 Mechanised Battalion Group. In a series of bitter fights between 9 September and 7 October, the SADF and UNITA achieved their primary objective of stopping FAPLA, which lost 1 059 dead and 2 118 wounded, along with 61 tanks, 83 armoured vehicles and 20 rocket launchers. The SADF lost 17 killed, 41 wounded and five armoured vehicles. The SADF then added a second mechanised battalion group – 4 SAI – and launched a counter-offensive, driving FAPLA back to Cuito Cuanavale. All Ratel variants were involved alongside a small number of Olifant Mk 1A tanks, with Ratel-90s taking on the Soviet tanks and the ZT3s scoring the first kills with the new missile.

The last time the Ratels would see action during the Border War was in April 1989, when some 1 600 heavily armed SWAPO guerrillas crossed the Angolan/Namibian border in an attempt to establish bases in the country before elections could be held. Most SADF units had been withdrawn in terms of the UN agreement and the South West African Territory Force had begun to demobilise, which had led the SWAPO leadership to assume there would be little organised resistance to their incursion, which was in contravention of the UN peace agreement. Standing in the way of their success were 1 200 SWA policemen and 63 Mechanised Battalion Group. Over nine days they fought SWAPO to a standstill, killing many of the guerrillas and driving the others back into Angola in some of the most intense fighting seen during the Border War.

A number of Ratels were destroyed in this fighting, including the one illustrated above, which was hit by RPGs and a BD 10 rocket launcher and burned out. All but one of the crew survived. Engineers are sweeping for mines around the hulk prior to it being recovered.

By the mid-1970s it was clear that the Eland-60 and -90 series of armoured cars would not be up to the demands of the southern Angolan theatre of operations, and that a vehicle with better mobility in rough terrain was required. That understanding was reinforced during the operations of the early 1980s, which not only showed that the Eland could not keep up with the Ratel infantry combat vehicles, but that the armoured car of the future also needed better firepower and protection. The search for a suitable armoured vehicle had its origins in the minds of two young Armoured Corps captains – both of whom later became generals – who began exchanging ideas as early as 1969 with a focus on the Eland's inadequate mobility and the short effective range of its gun.

ROOIKAT

It then became a very detailed and well-thought-out development programme that took into account many of the practical requirements learned from operations and combat in the harsh terrain and conditions of southern Africa.

In the mid-1970s South Africa instituted a project to develop an indigenous heavy armoured car better suited to their philosophy of deep, rapid mechanised strike forces. Wheeled armoured fighting vehicles rather than tracked ones were also called for. Not only were wheeled vehicles more reliable and mobile in the sandy semi-arid conditions of southern Africa, but perhaps more importantly meant that vehicles could drive with speed, covering great distances to their targets rather than being delivered by transporters or rail as tracked vehicles normally are. Landmines were always a factor and it was found to be much quicker to replace a damaged wheel from a landmine blast than it was to replace damaged tracks. Both 6x6 and 8x8 options were considered with an 8x8 eventually being the preferred option. This project was referred to as the New Generation Armoured Car, which eventually resulted in the Rooikat.

Development started with a formal user requirement specification (URS) issued in November 1976, followed by a series of studies and a decision in August 1978 to build three prototype vehicles being called for. These were delivered for testing in 1979. All were 8x8 and were equipped with a turret mounting a British 77 mm Mk II gun taken from retired Comet tanks. Of the three prototypes ordered, the first was based on the Ratel ICV, the second, on the Eland armoured car and the third on the British Saracen APC then in use. Trials were held in 1979 but none of these three vehicles was deemed satisfactory.

A new group of three different prototypes was commissioned in March 1982, which were evaluated in March 1984. They all featured different drive trains, suspensions and one was built in two variants with rear- and front-mounted engines, while the other was a 'heavy' variant. Two were 8x8 and the other a 6x6. At this stage there was also the requirement of later upgrading to 105 mm L7-type ordnance, and this led to one of these vehicles being a particularly heavyweight entry that was to all intents and purposes a wheeled tank and was given the nickname of Bismarck. The other two were nicknamed Cheetah Mk I, the 6x6, while the 8x8 was known as the Cheetah Mk II.

Model 2B, the rear-engine 8x8 variant, was selected, and a contract for six development vehicles was placed with Sandock-Austral (Pty) Ltd, four for operational test and evaluation by the Army and two for further tests by Armscor and Ermetek-The OT and E programme was carried out between September and December 1987. A further batch of three development vehicles was ordered – delivered in October 1988 – together with 28 pre-production vehicles for delivery in September 1988. The first squadron set of vehicles, essentially still pre-production models, was handed over in August 1989, and the first true production cars, albeit still with a few teething problems, followed in June 1990.

The New Generation Armoured Car Project

8x8 Concept Test-bed Prototypes

The test-beds were created to test various design features such as the suspension, soil mechanics and gunfiring stress mechanics. The soil mechanics and suspension tests were carried out on specially prepared soil lanes assimilating most of the different types of soil found in South Africa. The test area was prepared by the University of Potchefstroom, which also co-ordinated all the tests in 1979. All three of these 8x8 concept test-bed prototypes are on display at the South African Armour Museum in Bloemfontein.

CONCEPT 1 – Test-bed 8x8 based on a Ratel ICV

SPECIFICATIONS

Crew:	4

Engine:

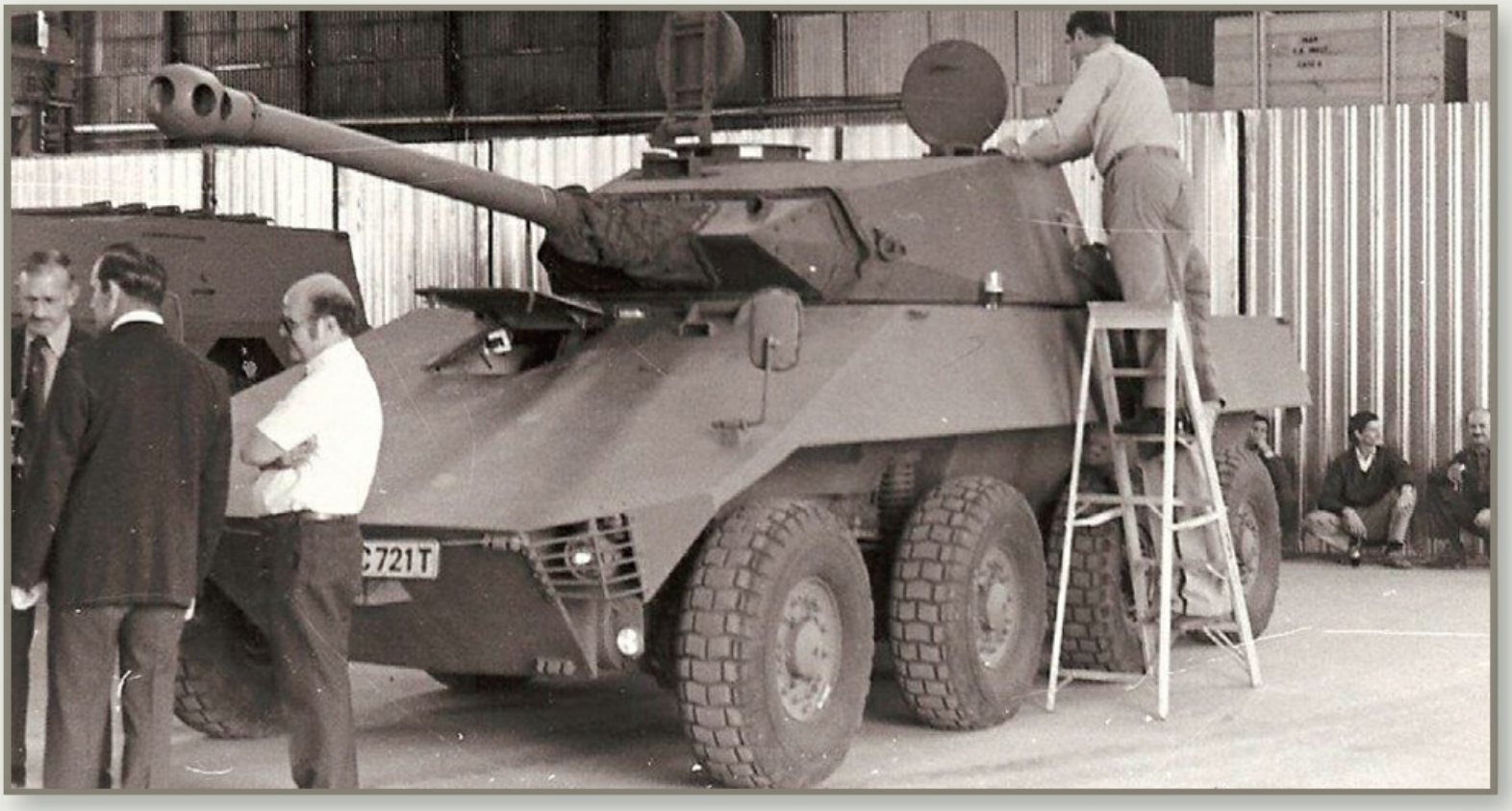
Model SI 2-DA, bussing, 6-cylinder in-line, liquid cooled diesel, 230 kW (308 hp) at 2 250 rpm.

Transmission:

Renk, HSV-106, Fully automatic, 6 forward and one reverse, manual selection 1-6 and reverse configuration – 8x8, transverse and longitudinal differential locks.

Speed:	105 km/h
Range:	960 km

CONCEPT 2 – Test-bed 8x8 based on a Eland



SPECIFICATIONS

Crew:	5
Speed:	75 km/h

CONCEPT 3 – Test-bed 8x8 based on a Saracen

SPECIFICATIONS

Crew:	4

Engine:

Cummins 210-NA, V8-cylinder, liquid cooled diesel, 156 kW (209 hp) at 2 300 rpm.

Transmission:

Allison, MT 650, fully automatic, 5 forward gears, 1 reverse, manual selection, 1-5 and reverse configuration – 8x8, transverse differential locks.

Speed:	83 km/h
Range:	175 km

CLASS 1 Prototype

SPECIFICATIONS

Crew:	4

Armament:

76 mm high pressure gun (RSA)

7.62 mm browning machine gun 60 mm breech loading mortar 8x81 mm smoke generator launchers

Ammunition:

76mm gun-APFSDS/T, HE.

60mm mortar – HE, smoke, illuminating.

Engine:

Mercedes Benz, OM402A, V8-cylinder, liquid cooled, diesel, 239 kW (320 hp) at 2 500 rpm.

Transmission:

ZF-6-hp-600, fully automatic, 6 forward 1 reverse, manual selectionl-3 and reverse configuration 6x6, with transverse and longitudinal differential Locks.

Speed:	104 km/h
Range:	1 300 km

Unique features:

Internally controlled tyre inflation/deflation system, turret mounted 60 mm mortar.

Comments:

This 6x6 vehicle was built by the firm Thyssen Henschell of West Germany in South Africa, at Sandock Austral (pty) Ltd around 1982/3.

The original turret was destroyed during trials.

The design was based on the minimum requirements for protection and power-to-mass ratio. The 76 mm high-pressure gun was considered standard for the new generation armoured car.

This vehicle can be found at the SA Armour Museum, without its turret.

CLASS 2B Prototype

SPECIFICATIONS

Crew:	4

Armament:

76 mm GT-4 gun, 2x7.62 mm browning machine gun, 60 mm breech-loading mortar, 6x81 mm smoke generator launchers.

Ammunition:

76 mm gun:APFSD/T, HE 60 mm mortar, smoke, canister illuminating.

Engine:

ADE, 90-volt, 10-cylinder, turbo charged, liquid cooled, inter-cooled diesel, 416 kW (558 hp) at 2 100 rpm.

Transmission:

HSV 106, fully automatic, 6 forward,

1 reverse, manual selection 1-6 and reverse; configuration – 4x4 or 8x8, high and low range. Traverse and longitudinal differential locks.

Speed:	120 km/h

Range:

Road	750 km
cross-country	300 km

Comments:

This class in a 8x8 configuration was eventually selected as the criteria for the New Generation Armoured Car. It was nick named cheetah and can be found at the SA Armour Museum in Bloemfontein.

CLASS 3 Prototype

SPECIFICATIONS

Crew:	4

Armament:

105 mm(L7) GT-3 gun, 2x7, 62 mm browning machine gun, 60 mm breech loading mortar, 8x81 mm smoke generator launchers, 105 mm-APDS/T L52, APFSDS/I', HEAT/T, HESH/I' WP/I'.

Engine:

MTU-V6-6396, V6-cylinder; turbo charged, liquid cooled diesel, 588 kW (786 hp) at 2 400 rpm.

Transmission:

ZF4Hp 2000, fully automatic, 4 forward, 1 reverse, manual selection, 1-4 and reverse, configuration – 8x8, transverse and longitudinal differential locks.

Speed:	road, 86 km/h
Range:	road, 1 000 km

Unique Features:

Hydro-pneumatic suspension system, turret mounted 60 mm breech-loading mortar.

Comments:

This vehicle was manufactured around 1982/3 and the heaviest of the three different classes built for evaluation. The turret was designed to accommodate a 105 mm L7 tank gun. The vehicle was built by Sandock Austral (Pty) Ltd who were technically assisted by a West

German firm. The project was shelved in favour of the class 2 B. This vehicle was nicknamed Bismarck and can be found in the SA Armour Museum in Bloemfontein.

R 9983

BLT 077 M

Rooikat goes into production

Full-scale development commenced in late 1985 with the vehicle first being unveiled to the public in October 1988 as the Rooikat.

Five advanced development models were completed in 1986/87 for extensive operational and technical evaluation trials. In 1987, work started on building four engineering development models for user evaluation trials and also to confirm modifications that resulted from the troop trials with the advanced development models.

The first Rooikat vehicles were completed in 1989 with the vehicle becoming operational with the SA Army in 1990.

In 1990 an upgrade and redesign programme was started by Reumech OMC to customise the Rooikat for the international market, and by 1994 the development of the Rooikat 105 variant with a 105 mm rifled gun was completed.

Rooikat Description

The hull of the Rooikat is of all-welded steel armour construction with the driver seated at the front, a three-man power-operated turret in the centre and the power pack at the rear.

Over the frontal arc protection is provided against penetration from the 23 mm AP (armour-piercing) rounds fired from the Russian ZU-23 LAAG, widely deployed in both ground and air defence roles in southern Africa. Trials have demonstrated that the hull design of the Rooikat provides a high degree of protection against anti-tank mines, particulary under the drivers seat.

The driver, seated on the centreline of the vehicle, can enter through the fighting compartment or through the single-piece hatch cover that opens to the left. The driver's station (including the essential controls such as foot pedals, steering wheel and direction indicators) is fully adjustable and, when driving in the closed-down position, forward observation is via three periscopes, the centre one of which can be replaced by a passive night periscope. When closed down the driver's periscopes can be cleaned by a compressed air cleaning system. The headlamps are under armour protection at the front of the vehicle.

A hull escape hatch is provided in each side of the hull, between the second and third axles, thus avoiding the crew being exposed to small-arms fire if they were to evacuate.

The commander is seated on the right of the turret with the gunner forward and below his position, and the loader on the left.

The commander is provided with eight vision blocks to give observation through 360°. Mounted in the roof, forward of the commander's station, is a day panoramic sight with a

magnification of x12. This enables the commander to observe through a full 360° without moving his head. The sight can also be slaved to the 76 mm gun or uncoupled.

The loader has a single-piece hatch cover that opens to the rear, and is provided with two periscopes. These can be traversed to allow observation of the terrain on the left side of the vehicle.

The gunner has a roof-mounted periscope sight which has x8 day and night image intensification channels and an integral laser range-finder. The gunner also has an auxiliary sight as used in the Ratel-90 vehicle. If required, the commander of the Rooikat can override the gunner.

The three man combat turret was designed, developed and manufactured by LEW and is a world-class leader in the combat-reconnaissance role. Interior space is reminiscent of a main battle tank turret, making this a superior turret for long-duration operations, such as deep-penetration and reconnaissance.

Turret traverse and weapon elevation feature solid-state electric controls for both gunner and commander, with manual emergency back-up. Traverse is through a full 360° with elevation limits from-10 to + 20°. The commander has a single control handle and the gunner twin control handles.

The digital fire-control system receives information from a laser range-finder and a number of sensors including cant and wind speed. Ammunition type is set manually. The Rooikat can engage and hit targets with a high probability while it is moving across rough terrain.

Ballistic offsets are automatically computed and implemented when the laser range-finder is triggered, to compensate for various factors affecting the ammunition ballistics. The offsets are implemented both in the sight (electronics sight slaving) and the main weapon (auto lay) and a ready-to-fire indication appears in the gunner's field advising him to fire. Total reaction time from lasing to firing is typically around two seconds.

The fire-control system provides automatic fire control by computing and implementing the ballistic offsets for the ammunition type selection by taking into account target range (automatic from laser range-finder), target speed (automatically derived by tracking the target), manually entered environmental data (air pressure, ambient temperature, ammunition temperature, headwind), crosswind speed (automatically sensed), weapon tilt (cant automatically sensed), and gun jump characteristics of the main weapon.

The fire-control system has BITE (Built-in Test Equipment) which enables any faults to be traced immediately and rectified through the substitution of line-replaceable units.

Armament

Main armament comprises a 76 mm/62 calibre gun which was developed at LEW and has the same chamber volume as the Italian Otobreda 76 mm compact naval gun but fires different ammunition in keeping with its role. The ammunition of the naval gun can also be fired by replacing the percussion primer with an electric primer. The 76 mm GT4 gun was chosen for the Rooikat for a number of other reasons including the larger number of rounds capable of being carried when compared to a 105 mm gun, particularly relevant for long-range raiding operations far from logistic support, the ease of handling ammunition when moving across-country and the optimum selection of recoil forces and firing impulses for maximum crew operational effectiveness.

The stabilised 76 mm gun has a vertical sliding semi-automatic breech block and is fitted with a thermal sleeve and concentric glass fibre fume extractor. The recoil system consists of a concentric hydro spring with an external replenisher with maximum recoil being 370 mm.

A 7.62 mm coaxial machine gun is mounted to the left of the main armament, while a similar weapon is mounted at the commander's position for use in the ground and air defence roles. This is skate-mounted so that it can be moved around the commander's hatch. An ammunition resupply hatch is provided in the left side of the turret.

Mounted either side of the turret rear is a bank of four forward-firing electrically operated 81 mm smoke grenade dischargers. The Rooikat can also lay its own smokescreen by injecting diesel fuel into the exhaust outlet atthe rearofthe hull on the left side.

In total, the SANDF has taken delivery of 240 Rooikat vehicles.

Rooikat is the Afrikaans word for the African Lynx.

SPECIFICATIONS

Crew:	4
Dimensions:	
Length	8 200 mm
Width	2 900 mm
Height	2 800 mm
Wheel base	2 032 mm
Ground clearance	400 mm
Performance:	
Top speed	120 km/h
Range on road	1 000 km
Fording depth	1 500 mm
Gradient ability	70%
Side slope (%)	30%
Trench crossing	2 000 mm

Fuel capacity:	540 litres
Engine:	
10-cylinder water-cooled diesel 414 kW (563 hp).	
Weight:	28 000 kg
Steering:	
Power assisted, front four wheels.	
Suspension:	
Internally driven trailing arms, coil springs and shock-absorbers electrical system – 24-volt (6 batteries in 2 banks).	

Looking to expand the capability of the Rooikat, Reumech OMC created a variant with a 105 mm gun capable of delivering a heavier punch over greater ranges and defeating virtually any operational armoured vehicle at the time. Development of the 105 mm Rooikat was completed in 1994.

ROOIKAT 105 mm

The obvious difference between the 105 mm and standard Rooikat was the different gun barrel which has a thermal sleeve, conspicuously-larger fume extractor with an oblong cross-section, and a tapering base. All of the mobility, protection, electronic, and ergonomic features of the Rooikat 105 are the same as in the standard Rooikat. The only significant changes are a slightly increased length owing to increased gun overhang, and an extra 500 kg of combat weight.

The 105 mm was considered an impressive vehicle for its class, however the SADF was satisfied with its 76 mm Rooikats and Reumech OMC looked to the export market. Unfortunately in the 1990s there was a global glut of Soviet era AFVs and to date the 105 mm variant hasn’t yielded any customers. Only one prototype was ever manufactured.

Self-Propelled Air Defence System (SPADS)

Project Prima was another interesting project based on the Rooikat platform. If the SADF was lacking in one key area while on external operations in southern Angola, it was providing anti-aircraft support for its mechanised combat groups, particularly an air defence gun and missile system that was capable of keeping pace with the highly mobile South African armoured fighting vehicles. This requirement led to the creation of the ZA-SPADS, Self-Propelled Air Defence System. The concept design and prototype development was contracted by Armscor and Kentron to be carried out in conjunction with LEW. The final project study was completed in July 1983 from which emerged the concept of a pair of complementary self-contained vehicles, both with their own short-range radars for target detection and designation. The one vehicle would be fitted with twin 35 mm guns while the other with ground-to-air missiles. They would be known as the Self-Propelled Anti-Aircraft Gun (SPAAG) and the Self-Propelled Anti-Aircraft Missile (SPAAM). A stretched Rooikat chassis was chosen as the weapon platform for both systems. This was logical considering the Rooikat 76 mm would be part of the combat group, thus ensuring similar mobility and a compatibility of spare parts.

Self-Propelled Anti-Aircraft Gun (SPAAG)

LEW designed a totally new 35 mm gun and ammunition feed system which was much lighter than comparable weapons, as well as having only 200 parts, making it very easy to maintain in the field. The choice of calibre for the gun was 35 mm as the SA Army was already widely using this standard NATO size, which was also being manufactured in South Africa by Pretoria Metal Pressings (PMP). The turret was also developed by LEW. The guns were mounted outboard, one on each side of the turret. The radar was developed specially for the SPADS by ESD in Stellenbosch representing at that time a true state-of-art radar technology.

Self-Propelled Anti-Aircraft Missile (SPAAM)

Surface-to-air missiles are used to engage targets beyond the range of an anti-aircraft cannon, the two weapon types complementing each other to provide effective air defence. The SPAAM was designed to use the locally developed missile, then known as the New

Generation Missile (NGM) and also as the South African High Velocity (SAHV) missile, later further developed as the Umkhonto missile. The basic vehicle was similar to the SPAAG, in that the turret, radar and most other sub-systems were identical, also fitted with a detection radar and a tracking/range-finding radar, which in this case also served to provide the command link to the missile. Although the SPAAG and SPAAM had been designed to operate completely independently of any other vehicle, operationally they would form part of a troop comprising three SPAAG vehicles and one SPAAM. It was designed so that the troop would be complemented by a support train carrying fuel, ammunition and spare parts to ensure the air defence system was self-suffienct and able to operate away from main supply depots for long periods of time. This entire system was completely designed and developed in South Africa, which allowed the close integration of the gun and missile defence systems to provide a very effective deterrent against any form of air attack against the Army's mobile ground fighting forces. Upon the withdrawal from SWA/Angola this need diminished and with defence funding also massively cut, the project was eventually terminated with only a single prototype of both systems having being manufactured.

The Combat Vehicle Electric-drive Demonstrator (CVED)

South African defence industry engineers have never been shy of exploring innovative ideas. One such concept was that of an electric-powered armoured vehicle, which dates back to the late 1980s when Armscor started the E-drive programme with the development of an electric-drive Ford *bakkie* (pickup) in co-operation with the then University of Natal. In 1993 the design engineers of then Reumech Ermetek, modified a MAN 8x8 truck with electric hub-motors on first four and later on all eight wheels. The beauty of electric-drive vehicles is that they have no axles, drive shaft or gearbox which allows far greater design flexibility than a mechanical-drive system. With electric-drive all that is required are cables, which can be easily routed anywhere. The design team developed the electric-drive MAN truck as a demonstrator for the SANDF in 1996. They then ran numerous field tests from then until 2001, in the mountains around Mpumalanga, Namibia's deserts and even in German snow fields. Having proved its practicality, the SANDF approved the fitting of a Rooikat chassis with an electric-drive to evaluate the E-Drive technology in a complex combat system using the Rooikat as the technology carrier. The converted Rooikat became known as the combat vehicle electric-drive demonstrator (CVED). A standard Mercedes Benz diesel engine was upgraded by MTU, increasing the power output from 315 kW to 450 kW but reducing the torque as required by the electric alternator, and changing the fuel management system so that the best consumption was not at maximum torque but at the optimal operation point for the electrical drive system. An electric motor was fitted in each wheel, each motor having a diametre of less than 50 cm These are permanent magnet motors and the Armscor E-Drive team also developed the electronics to drive the motors. The replacement of the mechanical drive system with the electric-drive system, including the storage batteries, reduced the weight of the Rooikat by just under 2 tons and freed up 15 m^3 of internal volume and space that could be used to mount extra armour or carry additional ammunition or fuel or a combination of these. The fitting of batteries allowed the vehicle to use its communications and electronic systems and to move limited distances at low speeds without having to start its diesel-driven generator thus giving it a stealth mode ability. In stealth mode, the hybrid Rooikat can tiptoe its 28 ton bulk so quietly through the bushveld with no more than the sound of the soft whine of the hub motors. Owing to limited budgets this project was shelved in 2012. That said, the system in the hybrid Rooikat represented a viable proof of concept and engineering technology that the engineers and design team can be justifiably proud of creating, and perhaps it can be said that the CVED project was even ahead of its time. The CVED project involved LMT, HIT, IAD, Nezrotek, Hutchinson (France), Kessler Magnet Motor (Germany) and MTU (Germany). Only one prototype was developed and tested at Gerotek.

K9
HYBRID ELECTRIC DRIVE
BGM 575 M

Design work on the MC-90 concept demonstrator armoured car commenced in mid-1993 by Mechem Consultants, the specialised research and development arm of Denel.

Demonstrator Armoured Car

MC-90 concept

The intention was to offer the Army a new light armoured car to replace the by then very elderly Eland design, and to do so at low cost – hence re-using standard Unimog powertrain and suspension elements and the same 90 mm turret used on the Eland-90 (from which they would have been taken as they were phased out) and the Ratel-90 to arrive at what was in many ways a miniature Ratel-90.

While the Army was reequipping with the 8x8 Rooikat, Mechem's Dr Vernon Joynt and others believed that there was still a requirement for a lighter vehicle in some roles and particularly for one that offered mine-protection and that could be airlifted. The MC-90 was intended to be that vehicle, although the prototype was just too high for loading into a C-130 without unbolting the commander's cupola. By then, however, the Army had already suffered massive funding cuts since 1989 and saw no relief on the horizon; in addition the entire Defence Force was being led astray by advisers at the Ministry level, who argued that South Africa should never deploy forces outside its borders, which neatly removed the need for an air-transportable vehicle. Some years later the Army briefly considered keeping at least one squadron of Eland-90s to give some air-transportable armour capability, but that too was overlooked in its scramble to phase out older equipment – a decision regretted later.

The prototype was completed in mid-1994 and it was shown for the first time late in

1994. In the designation MC-90, M stands for Mechem, C for Concept and 90 for the calibre of the main armament in mm. The vehicle has also been referred to as the Springbuck armoured vehicle.

The MC-90 has an all-welded steel armoured hull that provides protection from small-arms fire and shell splinters. The driver is seated at the front, with the two-man turret in the centre and the engine at the rear. The driver has a single-piece hatch cover above his position and has forward observation through bulletproof windows to his front and sides. In the left side of the hull there is a small door that opens to the front while in the right side there is a small door that opens to the rear. These allow the crew to gain access and should the need arise, quickly leave the vehicle.

The MC-90 is recognisable by its distinct high hull with visible axles and the driver's centre forward position with large angular bulletproof windows.

Like all South African-designed armoured vehicles, the hull has been designed to provide a very high degree of protection against anti-tank mines, combining careful shaping of the lower hull, high ground-clearance (greater space for a pressure wave to disperse before striking the hull) and careful internal design to prevent components being transformed into projectiles by the shock of a mine detonation. The Unimog running gear and the high ground clearance also gave much better cross-country mobility than the Eland, while the added height would have made the vehicle much easier to use in thick bush, where the crews of the very low-slung Elands often had to operate virtually blind, being unable to see over the bush around them. The combat weight of 7 tons was within reasonable limits for good mobility by a small 4x4 and would have allowed two cars to fit into a C-130.

This turret is of welded steel armour with the commander, who also loads the standard 90 mm low-pressure gun, seated on the left and the gunner seated on the right. The commander has a raised cupola for observation through a full 360°. Armament comprises the combat-proven 90 mm gun fitted with a muzzle brake, firing various ammunition, including high explosive, high-explosive anti-tank and smoke, a 7.62 mm coaxial machine gun and 7.62 mm machine gun on the commander's cupola. A bank of two electrically operated 81 mm smoke grenade dischargers are mounted either side of the turret firing forwards.

Despite proposals for different variants, which could have included a scout vehicle with the Ratel-20 turret and an APC variant, this vehicle never went into production. The prototype has been restored and can be seen at the SA Armour Museum in Bloemfontein.

The RG41 is the third vehicle to result from the decision by BAE Land Systems South Africa to broaden its focus from their original range of protected vehicles (RG31, RG32M, etc) to look at including a true range of combat vehicles. The first step was to acquire the rights to the Iguana which became the RG34; the second was the introduction of the RG35 series and the third the RG41 which is essentially a high-end level ICV platform.

RG41

The RG41 was developed to combine the mine and IED protection of the MRAP type of vehicle with the ballistic protection and tactical mobility of a modern wheeled ICV. Development began in 2008, drawing on the experience gained in the Rooikat, the SA Army's own previous ICV projects and the RG31 family of MRAP vehicles. The focus was to design an 'affordable and highly mobile wheeled combat vehicle suitable for modern warfare'.

The result was a 19 ton 8x8 vehicle with an 11 ton payload, excellent mobility and able to mount most turrets or weapon systems typically found in mechanised infantry units.

One immediately apparent feature is the 75° approach angle, which totally outclasses similar vehicles and which will be of immense tactical value when taken together with the excellent 54° departure angle.

The cabin provides 14.9 m^3 of space and is exceptionally uncluttered. The driver has been positioned very far forward to give the best possible field of view for cross-country movement, and there is space for, in a typical configuration, a two-man turret, a section commander and seven infantrymen. Access is by means of a large rear ramp, with roof hatches for the troops to operate from. The crew compartment is air-conditioned and there is a 51 litre drinking water tank.

Mine protection is provided by a new semi-V shaped modular hull design that allows the vehicle to combine MRAP levels of protection with the lower ground clearance needed to keep the overall height down for a combat vehicle. The design allows the forces of a mine detonation to be partly absorbed by this structure, partly deflected and partly distributed to the total vehicle with no permanent damage to the upper hull and no deformation of the floor. The modular structure of the lower hull, which is separate from the rest of the vehicle, facilitates repair in the field workshops that can simply fit pre-built sections to the RG41. The flat-bottom mine-protection technology was first tested by Land Systems South Africa in 2002, with small and then larger charges, to demonstrate that a relatively low-ground-clearance vehicle with a large internal volume can be constructed to provide protection against large TNT landmines without using a V-shaped hull.

SPECIFICATIONS

Crew:	11
Dimensions:	
Length	7 780 mm
Width	2 800 mm
Height	2 380 mm
Wheelbase	(1 – 2 axles) 1 693 mm
	(2 – 3 axles) 2 257 mm
	(3-4 axles) 1 550 mm
Ground clearance	440 mm
Angle of approach	64°
Angle of departure	54°
Mass:	
Curb	18 200 kg
Payload	9 800 kg
GVM	28 000 kg
Performance:	
Top speed	100 km/h
Grade ability	70%

Turning circle, curb to curb	19 m

Protection Levels:

Ballistic – STANAG 4569 level 2 (optional to level 4/5).

Blast – STANAG 4569 level 4A/3B (optional to level 4B).

IED-undisclosed

Engine:

Make – Deutz

Model -2015TCDV6

Maximum power (DIN)-390kW@ 2 100 rpm

Maximum torque (DIN) – 2 130 Nm @ 1 300 rpm

Transmission:

Make – ZF5Hp902

Type-5-speed with integral 2-speed drop-down.

Transfer Box:

Make-BAE systems (gear ratio)

Type – 17 000 series

Steering System:

Type – twinsteer, power-assisted, fully-integral system.

Suspension:

Type – independent

Springs – hydro-pneumatic strut

Shock absorbers – hydraulic

Brakes:

With integral shock absorber.

Main brake systems pneumatic disk brakes with ABS.

Parking brake spring activated, air release disc brakes on all 4 rear wheels.

Electrical System:

Voltage – 24-volt
Alternator – 3x200 A

The Mbombe is a six-wheeled armoured infantry fighting vehicle. It can be configured to an armoured personnel carrier, wheeled infantry fighting vehicle, anti-tank missile carrier, mortar carrier, ambulance or a command post vehicle.

MBOMBE

It does not use the traditional V-shaped mine-resistant design but a new revolutionary South African-designed. mineresistant honeycomb flat-hull technology. This innovation is a world first that allows the Mbombe to offer a new breed of armoured vehicle technology to the global market. The flat-hull design gives it a low silhouette, reducing its target profile and centre of gravity so typical of vehicles in this segment.

The Mbombe can withstand a 10 kg TNT blast under any wheel or anywhere undertits flat hull (STANAG level 4a and 4b). Paramount claims that crew and troops will survive a 50 kg IED blast from 5 metres away. This vehicle is better protected against landmines and IEDs than many current vehicles in use by NATO forces.

The early Mbombes were fitted with a turret and armed with a 30 mm dual-fed cannon and coaxial 7.62 mm machine gun. Other manned or remotely controlled turrets can be fitted.

This armoured infantry fighting vehicle has a crew of three and accommodates eight troops. Crew and troops enter and leave the vehicle via the rear ramp. In case of emergency occupants can leave the vehicle via roof hatches that are normally used for observation or launching anti-aircraft missiles.

The Mbombe is powered by an unspecified turbocharged diesel engine, developing 450 hp. The engine is mated with a 6-speed automatic transmission. Commercial automotive components are used wherever possible in order to reduce production and operating costs. A central tyre-inflation system is fitted as standard. The Mbombe has good cross-country performance owing to its three axles and independent suspension. It can be fitted with an additional fuel tank for extended operational range.

The Mbombe was first revealed in 2010 and named after a legendary African warrior.

The lead customer for the Mbombe are the Jordanian Armed Forces who placed an order for 50 vehicles at the 2014 Special Operations Forces Exhibition and Conference.

SPECIFICATIONS

Crew:	2 + 1 + 8
Dimensions:	
Length	7 715 mm
Width	2 800 mm
Height	2 549 mm
Wheel base	(front) 2 300 mm

	(rear) 2 240 mm
Ground clearance	430 mm
Angle of approach	40°
Angle of departure	54°

Mass:

Cub weight	17 000 kg
GVM	22 500 kg

Performance:

Top Speed	110 km/h
Turning circle	24.5 m
Range	1 000 km
Gradient ability	60%

Protection Levels:

Ballistic – STANAG 4569 level 3
Blast – STANAG 4569 level 4a and 4b

Engine:

336 kW 1600 Nm turbo diesel
Transmission – automatic

Brakes: Pneumatic disc (ABS Ready)

Electrical system: Voltage 24-volt

MBOMBE

BLZ160 M

The eight-wheeled Badger has been developed to replace the Ratel in the mechanised infantry battalions, offering far better mobility, firepower and protection than the six-wheeled Ratel. The long-term intention is for the Badger platform to also serve as the basis for other tactical vehicles, potentially including its use as the basis for a future Rooikat replacement. The Badger has been derived from the Patria armoured modular vehicle (AMV), the decision not to industrialise a local design having been taken when it became clear that funding would not allow an initial order that would justify the investment. In fact the original first order for 264 vehicles had to be trimmed to 238 after delays saw cost escalation make itself felt.

BADGER

Those 238 vehicles will equip two mechanised battalion groups and be used in several other roles. The remainder of the mechanised infantry will continue to use the Ratel for the time being.

The AMV has been further developed by Denel Land Systems to the point where the Badger has more than 70% local content. That includes the Light Combat Turret; the 30 mm cannon, the 60 mm breechloading mortar, all developed by DLS; the Ingwe anti-tank missile developed by Denel Dynamics; mine-protection employing new ‘flat-bottom’ technology developed by Land Mobility Technologies (LMT), essentially a blast and shockabsorbing box between the hull bottom and the floor; add-on armour developed by Armscor’s Armour Technology institute; and an entirely new internal fit and new rear door developed by LMT.

The Badger is armoured against 30 mm AP over the frontal arc and 23 mm allround with internal spall lining, and can absorb a 6 kg mine anywhere u nder the vehicle, with the added advantage of an 8x8 vehicle of being able to continue/moving tactically even after losing a wheel, and.able to get itself out of a kill zone after losing any two wheels.

A filter and over-pressure system protect against gas or biological agents, and there are explosion suppression systems in the crew and engine compartments. An auxillary power unit allows the vehicle to keep systems live and batteries charged without running the engine.

The Light Combat Turret is unique among ICVs, the Badger having a single basic turret that is fitted with different weapons and sight modules for the different variants, greatly reducing the acquisition and through-life cost and simplifying maintenance and training. The turret has an electric stabilisation and all variants have day/night sights, the type of fire-direction system and sights differing among the variants:

- The section variant is armed with the DLS CamGun externally powered, cam-operated, dual-feed 30 mm cannon, which has a range of 4 000 m and exceptional accuracy in its closed-breech ‘sniper mode’. It has a stabilised panoramic commander’s sight and a primary-stabilised main sight with auto-tracking.

- The mortar variant is armed with the DLS breech-loaded, water-cooled 60 mm mortar, which has a range of 6 000 m in indirect fire and 1 000 m in direct fire, making it a useful dual-purpose fire-support weapon.
- The anti-tank variant is armed with Denel Dynamics' Ingwe laser beam-riding missile, which has an effective range of 5 000 m.

BLZ 161 M

- The command variant is armed with a 12.7 mm machine gun in the interests of freeing

space in the turret for command and control equipment.

- All variants have a co-axial 7.72 mm machine gun.

The crew compartment is fitted with side-mounted seats with full harnesses, and has a zipped canvas 'bin' for personal kit behind each seat, eliminating the danger of loose items flying around inside the vehicle in a mine-strike. The entire interior is air-conditioned, and there is a 150 litre cooled *water* tank with taps in the section compartment and at the driver's station.

The powered rear door is fitted with stowage for section weapons – light machine gun, 40 mm six-round grenade-launcher, anti-tank rocket launcher, 60 mm patrol mortar and ammunition – enabling the crew to grab those weapons on the way out of the vehicle, instead of struggling with them inside. Two rear bins provide space for entrenching tools and other equipment.

Situational awareness for the infantry section is provided by an all-round video system with display screens for the crew and section commanders and in the infantry compartment, which can also be used for briefing purposes.

Note: These photographs of the Badger are of the engineering development model vehicles and the production vehicles may differ slightly in some respects.

SPECIFICATIONS

Crew:	11 (section variant)
Dimensions:	
Length	7 7500 mm
Width	2 830 mm
Height (depends on turret)	3810mm
Ground clearance	430 mm
Mass:	
Combat weight	26.6 tons
Performance:	
Top speed	108 km/h
Range	800 km
Gradient ability	60%
Side slope	30%
Approach angle	44°
Departure angle	39°
Vertical step	60 cm
Ditch crossing	2m
Fording depth	1.5 m
Turning circle	20.4 m
Tyres	14.00R20
Wheel travel	400 mm
Suspension	8x8

Engine:

405 kW fuel-injected Scania diesel

Transmission-ZF 7+1 automatic

R 118-116

Chapter 8

SOUTH AFRICAN LANDMINE DETECTION VEHICLES

Landmine-protected vehicles developed over the years followed a defensive approach to protect personnel and vehicle components. As the threat escalated, with more landmines being laid and increased use of double mines laid in various forms, the South African security forces had to deal with more frequent incidents and more severe detonations.

This led to the development of a range of mine-detection vehicles that were then mainly used to sweep roads early in the morning and late in the afternoon. This technology was refined in the 1980s and several decades later has become the Husky mine-detection vehicle system that is used very successfully in conflict zones around the world and is arguably the premier landmine- and IED-detection vehicle.

This strange-looking vehicle was designed to detonate and detect mines, and used by the SA Army in the operational area of the Caprivi Strip in the early 1970s. It was the first South African-designed mine-detonating vehicle.

HOTNOTSGOD

The Hotnotsgod was powered by a Ford and International Harvester tractor on top of which was the driver's mine-protected cab. Extended in front was a long arm with a set of ten heavy wheels, used to detonate mines. It also had a set of 20 rakes which could penetrate soft soil to a depth of 10 cm, to dig up mines as it went along.

It was designed to be operated in a number of different ways, including by remote control instead of the driver being in the cab. There were two methods for remote control, either by a cable link or, for distances up to 500 m depending on line of site, by radio. The remote controls were very simple, comprising one switch for acceleration and braking and another for turning left or right. It was mostly operated by direct control with the driver in the landmine-protected cabin.

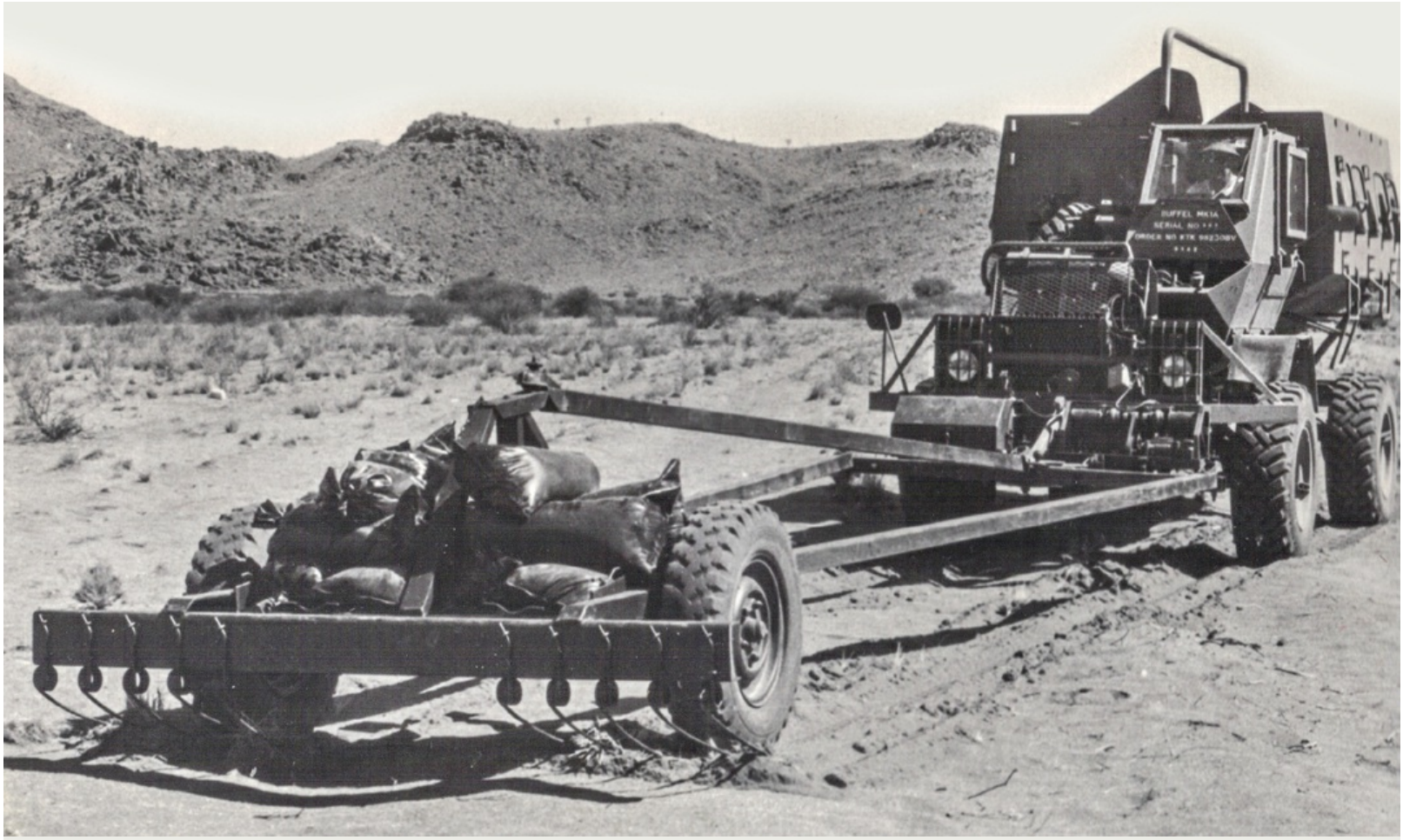
Repair time in the field after a wheel detonation of a mine was around 20 minutes.

The use of remote control was to get the operator as far away from the detonation as possible, keeping in mind that in those early years very little was known about areas and angles of landmine blasts or of fragment distribution.

Hotnotsgod is the Afrikaans word for a praying mantis insect.

SPECIFICATIONS

Crew:	1 driver
Dimensions:	
Length	10 500 mm
Width	2 800 mm
Height	3 280 mm
Turning circle	21 m
Width swept by front wheels	2,6 m
Mass:	7 000 kg
Power source:	
Ford and International Harvester tractor	
Transmission:	
Hydrostatic speed – 30 km/h Number of front wheels – 10	
Suspension:	
All front wheels independent	



Used for mine-clearing, the Road Runner was a single-axle outrigger bogie fitted with mine-lifting rakes. It was pushed ahead of the vehicle – usually mine-protected – at the end of a beam outrigger which placed the Road Runner axle up to ten metres ahead of the vehicle's front axle. The bogie could be pushed by any vehicle with sufficient power, its tracks matching that of the vehicle.

ROAD RUNNER

It was regarded as expendable in the event of a mine detonation. The beams were repairable if bent, and the steering trim assembly and pushing vehicle were generally not affected by the detonation.

The design was not without its challenges. With its wide turning circle, it was very difficult turning the combination around. In an ambush situation the Road Runner was sluggish and cumbersome, making it extremely vulnerable, not being able to clear the killing ground in a hurry. Its dead weight also made it difficult to get it moving from a standing start.

Role:

Landmine detection and detonation

Quantity manufactured:

18 for the SA Army and 25 for the SAP

First year of manufacture: 1973

SPECIFICATIONS

Dimensions:

Bogie track width	to suit vehicle
Bogie net mass	175 kg
Axle – Neidhart capacity	450 kg
Bogie load capacity	360 kg
Rims	14 cm

Outrigger beams were made from 7.6 cm square tubing.

Outrigger beam lengths, up to 6 metres, i.e. bogie axle up to 10 metres from end of vehicle's bumper.

Steering trim:

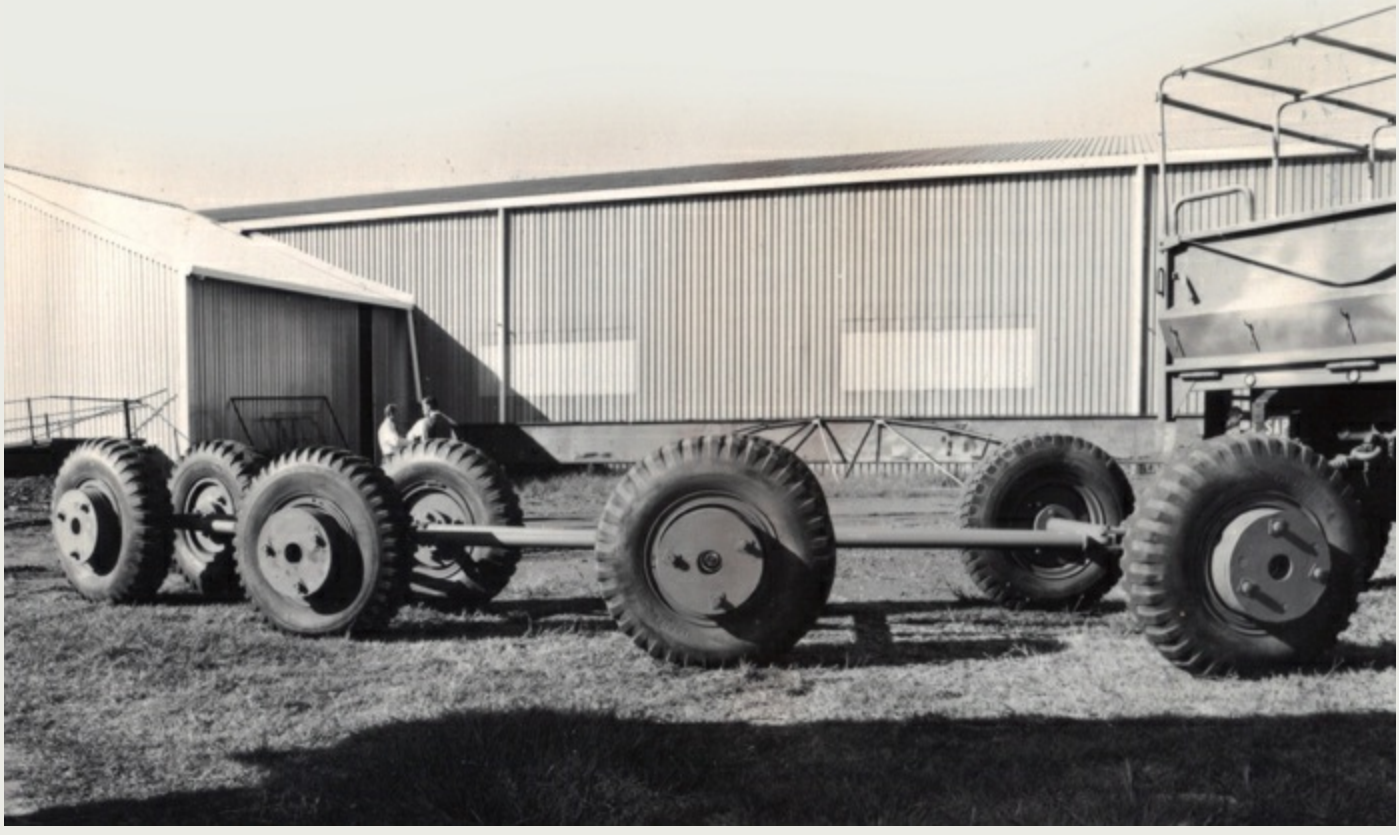
By two starter motors driving a 30:1 worm gear reduction box via 2:1 V-belt.

The motors were 12 V, 150 A with power being obtained from the vehicles electrical system.

Attachment to vehicle:

Steering trim was attached to bumper mounting points.

Steering trim control: 2 way switch



The Duisendpoot was a mine-detonating trailer that went through many modifications and four different Marks over the years.

MK I and IA
DUISENDPOOT

First manufactured in 1978, the Mark I and IA were fitted with four sets of axles with eight heavily weighted wheels, fitted in such a way they covered the width of a vehicle.

Essentially, it was designed to be towed behind a mine-detection vehicle such as the Spinnekop, to detonateany mines it may have missed. It was also towed behind mine-protected vehicles capable of pulling the six ton trailer.

The Duisendpoot proved its value time and again in the operational area of SWA as a mine-detonating trailer that was inexpensive to repair, and which could be done in approximately 30 minutes after a wheel detonation.

Apart from its simplicity in design, it was also much easier to operate than the Road Runner and Hotnotsgod, as the Dusiendpoot was pulled behind rather than pushed in front.

Duisendpoot is the Afrikaans word for a millipede.

SPECIFICATIONS

Quantity manufactured:	
6 Mk I for the SADF, 2 Mk I As for the SADF	
Role: Used as a mine detonator	
Speed:	20 km/h
Total mass:	6 000 kg
Number of axles:	4
Number of wheels:	8
Dimensions:	
Width sweep of trailer wheels	820 mm - 2 475 mm
Turning circle	13 m
Total length	10 m
Total height	1.2 m

MKII and III
DUISENDPOOT

In the earlier Marks the trailer didn't hold steady and was prone at times to snake behind the towing vehicle. This was possibly due to its light weight, being towed in soft sand and that it had no wheel bearings.

Mark II and III overcame this problem by increasing the mass through large steel ballast blocks, creating two separate four wheeled trailers.

Both Marks could be repaired in around 30 minutes after a wheel detonation.

SPECIFICATIONS – MK II

Role:	
Detonate mines that cannot be detected	
Quantity manufactured:	
1 for the SADF	
First year of manufacture:	1981
Speed:	20 km/h
Total mass:	8 000 kg
Number of axles:	4
Number of wheels:	8
Dimensions:	
Width swept by wheels	820 mm-2 475 mm
Turning circle	10 m
Total length	10 m

Total height	1.6 m

SPECIFICATIONS – MK III

Role:

Detonate mines that cannot be detected

Quantity manufactured:

2 prototypes for the SADF

Speed:

Complete unit	40 km/h
halfunit	90 km/h

Total mass: 7 200 kg (900 kg per wheel)

Number of axles:	4
Number of wheels:	8

Dimensions:

Width swept	
by wheels	600 mm – 3 020 mm
Total length	9m
Total height	1.75 m

Role:

Mine-detection vehicle for the Duisenpoot

Quantity manufactured:

1 prototype for the SA Army

SPECIFICATIONS

Crew:	2 + 1
Dimensions:	
Length	6 537 mm
Width	2 460 mm
Height	3 000 mm
Wheel base	3 692 mm
Ground clearance	320 mm
Mass:	
GVM with no load	5 100 kg
permissible load	9 652 kg
Perfermance:	
Top speed	80 km/h
Fuel tank capacity	240 litres
Range	820 km

Engine:

Bedford, diesel 6-cylinder in line water cooled.

Gearbox:

4-Speed ZF with synchromesh on 2, 3 and 4.

Transfer box:

Bedford type 4 wheel drive with high/low range.

Axle type: Hypoid fully floating

BOSLUIS

There was a perceived need for a dedicated mine-protected vehicle to tow the Duisendpoot. In reality this was not a necessity, as the Duisendpoot could be towed by any mine-protected vehicle capable of towing 6 tons. Only one prototype was ever manufactured. The wheels of the Bosluis came from a Hercules C160.

Bosluis is the Afrikaans word for a tick.

The Spinnekop was an unusual-looking vehicle with its high-mounted, narrow V-shaped monocoque cab for its crew of two, with the operator sitting in front, the driver behind with the engine compartment at the rear. A hydraulic pump, connected to the engine, provided power to the six wheels via hydraulic motors fitted in each of the wheel hubs. The wheels were mounted on outriggers. A South African-designed Milton mine detector was fitted to the front of the vehicle with rakes that were used in soft sandy conditions to either detect a landmine or turn them up. The thinking was that should a wheel detonate a mine, the quick coupling to the wheel would pull out and the wheel would sheer off in the blast. This resulted in a vehicle where it was quick and easy to replace wheels damaged by landmines in the field and be operational again within an hour.

SPINNEKOP

The Milton mine detector, landmine-clearing rake, skids and wheels were all hydraulically operated from a 135 litre reservoir. Should a landmine blast sheer off a wheel, the hydraulic pipes sealed off automatically. There were skid bars fitted to both sides of the Spinnekop. In the event of detonating a landmine and losing a wheel during an ambush, it could, in theory, drive its way to safety out of the ambush.

The Spinnekop was designed to tow the Duisendpoot (as shown in this photograph) which would detonate any undetected or unturned landmine it missed. When deployed operationally though, the Spinnekop was mostly used on its own without the Duisendpoot. Given its height from the ground, very narrow hull and the wheels not being directly below the hull, the Spinnekop was considered to be one of the safest mine-protected vehicles.

The SA Army took delivery of 18 Spinnekops in 1979. Although they were moderately successful, it was an exceptionally sophisticated vehicle that required a high degree of skill to operate and maintain which ultimately became too much of a challenge in the operational area. The Spinnekops were eventually withdrawn from service, making way for a new generation of mine-detection vehicles, the Chubby.

Spinnekop is the Afrikaans word for a spider.

SPECIFICATIONS

Dimensions:	
Length	7 m
Width	3.3 m
Height	3m
Performance:	
2-wheel drive	60 km/h
4-wheel drive	50 km/h
6-wheel drive	40 km/h
Detection speed	18 km/h (maximum)
Mass:	7 tons

Engine:

Deutz, type F61 912, straight 6-cylinders in-line 4-stroke air-cooled diesel with direct injection, delivering 80 kW at 2 500 rpm.

Transmission:

Hydrostatic with 2x6, 4x6 or 6x6

Suspension: Rub-axle

Fuel capacity: 100 litres

In 1977, Gielie Nel and Erich van Rensburg, both Citizen Force soldiers, received a three-month military call-up to the operational area of SWA. While operating the Spinnekop mine-detection vehicle they detonated a landmine. They take up the story…

We survived the ride

We were part of 18 Field Squadron, an engineering unit.

Specialised mine training was given just after we reported for duty and shortly afterwards two teams went to Eenhana for training on the Spinnekop mine-detection vehicle, called 'Ouma! The CSIR had given names to each of these vehicles.

The Spinnekop was operated by a crew of two: the driver and the sensor-pan operator, who also operated the Browning machine gun, mounted above him. The sensor-pan operator sat in the front of the Spinnekop and the driver behind him on an elevated seat, which allowed him to see over the head of the sensor-pan operator. A sliding roof hatch was fitted to the top of the Spinnekop to gain access into the vehicle.

Once a signal was picked up by the sensor-pans, of a metal object on the ground, an audible and visual signal was given, as well as a black flag that was dropped on the ground to mark the signal. Two, two-man teams would drive behind the Spinnekop in two separate vehicles to investigate the flagged signals. If it was a landmine, it was then dealt with accordingly, normally lifted.

Our training on the Spinnekop lasted for approximately four to five days with the CSIR project managers from Pretoria.

On the first operational trip with the Spinnekop 'Ouma', sweeping the notorious Oom Willie se pad, two cheese mines were lifted on a Sunday.

The next day, our six-man team moved out to Okatoppe, which, at that time, was a real hotspot for mine activity. A new Spinnekop, 'Suzy', was flown from Pretoria to Ondangwa in a C-130 'Flossie' and allocated to our team. From Ondangwa, we headed to Okatoppe, where we prepared our Spinnekop for operations. A day later, we were on our first operational deployment with 'Suzy'.

The road we had to sweep was from Okatoppe to Okankolo and back via another route, which we knew as 'the long route'. Okankolo was reached without detecting any landmines. Returning from Okankolo on the long route, we marked two mines with the Spinnekop, which were lifted by the other team members.

The Spinnekop engine located at the rear of the vehicle with Erich van Rensburg (left) and Sergeant Mike Holt (right).

Two days later, on 6 April 1977, we swept the short road to Okankolo again and this time, about 16 km from the tar road, we came across a smallish broken branch that was lying over the left-hand track of the dirt road. I asked Gielie, who was in the driving seat, if he could recall seeing this broken branch the last time we had swept this road. His answer was, “No!”

The next moment, I got a cold shiver down my spine and we detonated a mine with the right centre wheel of the Spinnekop. All this happened in split seconds. Smelling the ammonia released from the TNT explosion, we immediately knew it was a mine detonation. Inside the ca b, we could feel the Spinnekop lifting up with a bounce. The cab was full of dust and fine black soot flakes rained down on us. Flames from the blast shot up between Gielie and me. I was sitting in the front of the Spinnekop, operating the sensor-pans and Gielie behind me, doing the driving. Our hair was slightly singed by this. The sliding roof of the hatch of the Spinnekop, was bent and the emergency roof was missing due to the pressure build up of the blast inside the cab. To get out, we had to use a little force to get the sliding hatch of the roof to open. Our immediate concern was to get out before we got shot at with a RPG-7.

The Spinnekop parked in the exact position and location where it denoted the landmine. Note the narrow dirt road, soft sand and savannah vegetation – suitable landmine planting conditions and ideal ambush environment.

Apart from the crew of two in the Spinnekop, the full combat mine-clearing team included two sweepers behind the vehicle.

Remarkably, the Spinnekop shows hardly any sign of damage after the blast.

The Spinnekop was driven back to the base by Gielie Net with the missing middle right wheel that was blown off from the blast clearly visible in the photograph.

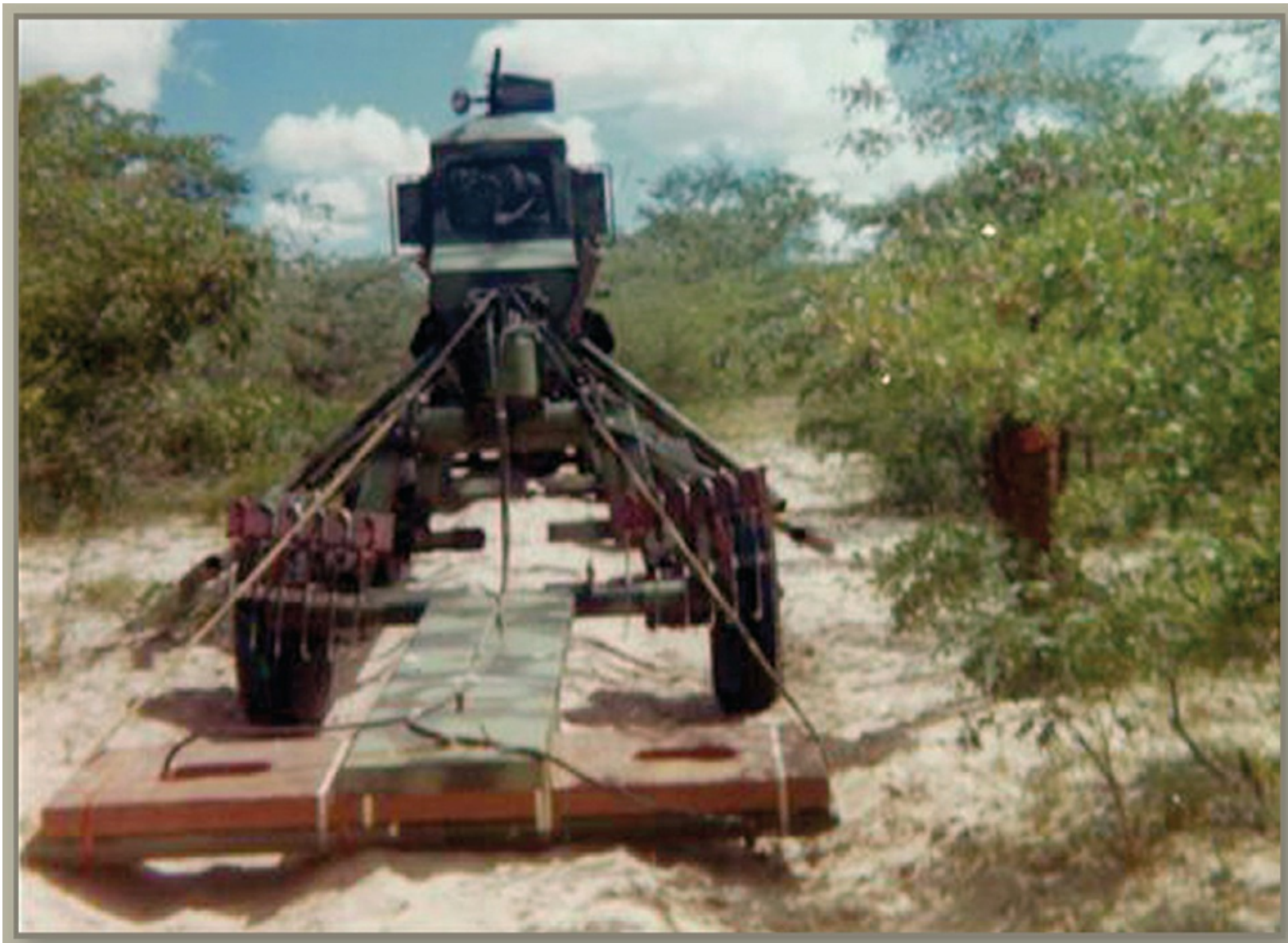
Some of the many TM-46 Soviet-manufactured landmines we recovered during our three-month camp.

We immediately did our antiambush drills, with the help of a section of 101 Battalion members, who were part of the sweeping operation as an escort to protect the mine team. The spoor of the mine layer was seen by 101 troops and the follow-up began. With the vehicle damaged, we didn't want to take any risks and implemented standard landmine-clearing drills, sweeping the road by hand, to look for more mines. We found two more mines 700 metres from the blast area.

The 101 Battalion trackers found the mine planter whose trail led to a nearby kraal where he was caught busy trying to cut the profiles off his shoe soles. He was arrested. It was quite a grim feeling to come face to face with this terrorist who had actually put our lives on the line.

Amazingly the Spinnekop was hardly damaged after this landmine incident, and we were able to drive it back to our camp where we, as a team, repaired 'Suzy'. We also added some modifications, which we thought would be necessary, such as adding spring-type rakes in front of the front wheels, which proved to be very successful on the next sweep. Two cheese mines planted approximately 100 metres from our blast hole, were raked out and exposed.

Although we were examined by the camp doctor and medics, the mine blast has left us with impaired hearing problems. We believe that thanks to the excellent design and engineering of the Spinnekop vehicle we were lucky to have survived the blast, being able to tell the tale today.



A day later after the landmine detonation the Spinnekop was repaired and operational, seen here with its modified rake on the front sweeping the dirt road.

One of the very early mine-detection concept vehicles designed by the Chemical Defence Unit (CDU) in the late 1970s was called the Gees. It was a light-weight vehicle with a single monocoquce capsule. The thinking was that as the average anti-tank landmine required a weight of around 300 kg to detonate, and by spreading the weight of an already light vehicle the ground pressure per square inch would be low, allowing this vehicle to drive over pressure-fused anti-tank mines without detonating them but most importantly being able to detect them. The Gees concept vehicle never went beyond a prototype, though the thinking was carried through to Project Chubby, where work had begun in earnest to develop a much more sophisticated mine-detection system.

Early Mine-detection Systems

The Gees.

What emerged in the early 1980s was a mine-detection vehicle called the Meerkat. It had a high level of protection for the operator and main vehicle parts while being light enough so as not to detonate an anti-tank mine. It was also able to be repaired within an hour in the field after a detonation. Equipped with sensors, it could sweep a road with limited false alarms, ignoring small metal objects and anti-personnel mines.

The Meerkat formed part of the mobile mine-detection system (MMDS), also known as the ‘Chubby System’ consisting of three vehicles (see photograph below). The first was the mine-detection vehicle, the Meerkat. The second vehicle, called the Husky, towed a set of Duisendpoot mine-detonation trailers and a third vehicle had back-up spare wheel modules and tools.

The Meerkat and Husky vehicles had the capability to detect anti-vehicle mines at speeds of up to 35 km/h by using pulse-induction-type mine detectors that were fitted to the vehicles. Interestingly the pulse-induction system was a new invention developed as part of

Project Chubby as there was nothing available in the market with the required capabilities. Mines that could not be detected would be set off by the mine-detonating trailers which were drawn by the Husky.

Damage caused by a mine explosion was easily repaired in the field by operators using the spare wheel modules for the vehicles and modular components for the detonating trailers.

The SA Army engineers operated 23 MMDS in the then SWA and the Northern Transvaal/Limpopo to sweep the border roads for landmines that were frequently laid by insurgents.

This concept was designed and developed by Armscor engineers, André Coetzee and Bernie Blaauw, with the support of Jannie van der Merwe and Gert van Niekerk.

André Coetzee was the designer of the Meerkat and project manager of Project Chubby. In August 1987 he was undertaking a final user evaluation of the Mobile Mine-detection System in South West Africa. While driving the Meerkat on a test run it detonated a landmine. André takes up the story…

I survived the ride

Our team consisted of Bernie Blaauw, Jannie van der Merwe, Riaan Kuhn and myself, all civilians working for Armscor. There were also SADF personnel from Director Projects, DTD and a team from the South African Corps of Engineers. We started the evaluation in Kaokoland, the 102 Battalion area, to see how the system would work in areas with narrow, one-track roads with rocky and rough patches that at times had quite steep gradients.

On 31 August, our third day of the evaluation, we left from Okangwati to sweep the road through to Epupa Falls, with myself as the driver and operator of the Meerkat and Bernie following with the Husky and Duisendpoot.

It was 12h20 and we were 61 km from Okangwati. Having had two false alarms: one, a piece of a Caspir grill and the other, a rock containing iron, the mine-detector alarm came on for the third time that day. It gave a signal from the right-hand detector just as I went down the embankment of a dry river where the left side of the road had been eroded by water. As per our standard operating procedure, I reversed with the detection system switched to high sensitivity (second time over the landmine) and found that, yes, there was either a landmine or a piece of metal in the ground. I marked the spot and called in the Sappers over the radio to carry out a final investigation with their hand held mine detectors. I realised that the chances were fairly high that this was going to be the first landmine to be detected with this Meerkat system in operational circumstances, because where I thought this supposed landmine had been laid was exactly as it was taught in the textbook.

When I drove over the landmine (for the third time) – BANG!!! The right rear wheel detonated the mine. I could feel my buttocks fully flatten the foam of the special mine-protected vehicle seat so that I actually bumped the steel plate underneath. The first thought to cross my mind was that this seat really does its job to protect you from spinal injuries. I could both see and feel that the rear end of the vehicle was thrown fairly high up into the air and then, as I felt the jerk of the seatbelts on my shoulders, the second thoughtto cross my mind was that without them I would surely have head injuries.

Back on Mother Earth I realised that I might be in an ambush and my first reaction was to man my overhead weapon system. I could not see anything on either of my sides-just blacksmoke and dust. Okay, next was to test the radio – yes, it was working and I gave the command for the troops to carry out an all-round protection and to come and check for anti-personnel mines so that I could disembark safely.

Whilst on the radio with the dust starting to settle a bit, suddenly my blood went cold for a second. Less than 1.5 metres from me was another UKA63 landmine, that had not exploded, deformed by, I suppose, the Cordtex that coupled it to the first mine.

The real fright for all of us was to come a good hour and a half later after everything was over and we were relaxed, drinking coffee in the shade of a thorn tree. The lieutenant from 102 Battalion told us that he was going to detonate the second damaged landmine. We said okay, completely forgot about it and immediately continued chatting, joking and laughing. Having found the perfect safe spot against the embankment of a dry riverbed about 15 metres from us, the engineer officer detonated it. You can imagine what a huge fright all of us unsuspecting bystanders got from the loud explosion being so close to us. Bernie dived to the ground and leopard-crawled for cover while the rest of us simply froze for a moment.

For me, as the designer of the Meerkat and project manager of the Mine Sweeping System (and for everyone else in the team), it was a great experience being able to detonate a mine in the operational area and to come off relatively unscathed and not even with ringing ears. The ultimate proof for all of us in the team was that the system worked and that it was safe to operate and would save lives.

The Meerkat vehicle was flung about four metres to the left. Visible is the missing back right wheel blown off in the blast.

André (right) being assisted by a corporal from the SA *Corps of Engineers to determine the type of landmine*.

Designed, manufactured, marketed and supported by DCD Protected Mobility, the Husky Mk III and the Husky 2G were significant upgrades on their predecessor, the 'Chubby', which was then configured into the combat-proven Vehicle Mounted Mine Detection System (VMMDS). The Husky Mk III upgrade resulted in it being type classified within the US Army, becoming the first South African armoured vehicle to achieve this status. The upgrade also conformed to the various MIL, STANAG, SAE and NATO specifications after having undergone intense product verification testing at the various US Army proving grounds during 2008 and 2009.

Vehicle Mounted Mine Detection System
HUSKY

The Husky upgrades included upgraded power pack, improved overpass capability and protection, four-wheel steering, RPG nets, cameras, high-sensitivity low-metal content and deep-buried detectors, ground-penetrating radar, powerful air blowers and a robotic arm with the design of the vehicle including a second crew member.

The Husky is a unique landmine-and IED-detection vehicle that is blast survivable, able to pass over pressure-fused anti-vehicle landmines without detonating them and field repairable within a short space of time. Suitableforusein both rural and urban environments, the Husky facilitates fast and efficient route clearance by creating safe passage for military convoys and civilian vehicles.

The VMMDS is the route-clearance system of choice by military forces worldwide. Apart from more than 1300VMMD vehicles in service around the world, the high regard for the Husky system is perhaps best reflected in the fact that in 1998 at a joint press conference held at the Union Buildings in Pretoria by the then presidents of the United States of America, Bill Clinton and Nelson Mandela of South Africa, President Clinton paid tribute to DCD Protected Mobility and the Chubby system by saying:

"I am very pleased that our Department of Defense has decided to purchase new South African vehicles called the Chubby. The vehicles will help us to remove mines more quickly, more safely and more efficiently."

Yet, the greatest accolade of all for the VMMDS was to come a decade later. At the annual meeting of the Association of the US Army in October 2011, in Washington DC, it was announced that the South African-made Husky 2GVMMD was one of the top 10 greatest military inventions in use by the US Army.

Since then, the US Army and US Marine Corps have together acquired about 1200 Husky vehicles.

Husky vehicles in service worldwide have been collectively subjected to more than 7 000

landmine and IED strikes with minimal operator casualties.

Operator survivability is achieved through the Husky's V-shaped hull and ability to shed secondary components in a predictable fashion – taken together, these two design features shield the driver from the worst impact of an IED blast.

The Interrogation Arm is a vehicle-mounted crane system designed to investigate and remove IEDs. The arm increases survivability by allowing for operation from inside the vehicle and because it was designed as an independent component, it can be attached to most vehicles already in theatre.

A Spare Wheel Module Trailer (SWMT) called the 'Red-pack' is a set of emergency repair spare parts and tools consisting of complete front and rear modules on either end of the Centre Support Maintenance Pack (CSMP). The CSMP contains selected spares, spare detector heads required by the commander to repair mineblast damage in the field in the minimum amount of time.

Husky Mk III with a Spare Wheel Module Trailer called the 'Red-pack'.

Husky Mk III with the three Mine Detination Trailers.

SWMTs are usually towed by the logistic support element in the route-clearance convoy during high-intensity operations. During low-intensity operations, the SWMT would normally be kept at the operational support base in the vicinity. In the four-wheel configuration, the

SWMT has air brakes with glad hands for connecting to the towing vehicle.

Three Mine Detonation Trailers (MDTs) which are designed to detonate mines with minimum damage to the trailers are required effectively to cover a three metre road width. Each axle has a different width to ensure that the wheels do not miss any sections of road surface. This is true even when travelling around corners.

Each trailer is fitted with a pneumatic brake system which is protected against blast damage. When a wheel is blown off, replacement hubs are available to make the system mobile again within 30 minutes.

The packing method of the VMMDS was designed and developed to safely transport the complete Husky System by rail, road and sea to any required location. The storage system also permits long-period preservation in any environmental condition.

This is achieved by bolting the various main assemblies to custom-made skeletal frames. These frames can be rolled into or out of the container, hold the components rigidly and prevent movement and subsequent damage during transportation. The frames are then rigidly fixed to the floor of the ISO container, preventing any shifting during transport. This system has proved very successful in practice.

The Husky can easily be unpacked, re-assembled and installed to bring the system to operating condition. After use the vehicle can be dismantled, repacked and preserved on its custom-made frame and rolled back into the container. The complete Husky and SWMT are fitted into three ISO containers which belong to the system.

In 2002, DCD Protected Mobility first demonstrated their autonomous-controlled Husky vehicle. Three experimental demonstrators were developed, namely: the Ground Standoff Mine-detection System (GSTAMIDS), the SKILPAD (2004) based on the Meerkat vehicle and the Route Clearance Platform Autonomous Control Kit (RC-PACK) based on the Husky vehicle (2013).

Assembling the Vehicle Mounted Mine Detection Systems, Afghanistan.

The GSTAMIDS programme for the US Army was aimed at autonomous vehicle operation to detect anti-tank mines on supply routes. The US Army selected the Meerkat as the suitable platform while other companies were selected as technology partners to supply the autonomous kits, ground-penetrating radar, GPS target location and the physicalmarking system.

The SKILPAD was a development based on the Meerkat for the US Army future combat vehicle enquiry in 2002. It was designed as a remote-controlled, highly manoeuvrable, mine-protected, field-repairable utility vehicle. It was intended to be customized to suit the specific operational requirement. The prototype demonstrated the physical capabilities of the vehicle with remote control

The RC-PACK, based on the Husky vehicle, was successfully demonstrated in October 2013 to the US Army at Fort Leonard Wood in the USA in the manned, tele-operation and semi-autonomous mode. This vehicle is the most advanced autonomous version of the Husky family of vehicles.

The Husky vehicle has demonstrated itself to be the most viable, efficient and versatile sensor platform as well as the vehicle of choice for operators involved in route-clearance missions around the globe, having seen service with the armed forces of South Africa, Uganda, Kenya, Great Britain, Australia, the USA, France, Canada, Spain and Turkey.

This is confirmed by Captain Chris Davis, 174 MAC Commander, Route Clearance, Kandahar City, Southern Afghanistan in an email sent to Jeff Kubik at TACOM.

Complete Vehicle Mounted Mine Detection Systems.

I survived the ride

From: Davis, Christopher G CPT USA TF THOR
Sent: Tuesday, March 16, 2010 12:09 PM
To: Kubik, Jeffrey CIV USA USAASC; Bienusa, Dale E USA Mr USA TF Castle PM-AMS
Subject: Husky Story

Classification: UNCLASSIFIED

Gentlemen,

I am Captain Davis, 174 MAC Commander - Route Clearance. We operate in Southern Afghanisatan, Kandahar City.

Two nights ago, 14 MARCH 2010, one of my Platoons ran upon a SVBIED near the Saraposa Prison (Downtown Kandahar).

Our Husky drivers were leading the convoy, when the blast went off at approximately 50 metres to the 10:00 position. The blast was so big it leveled the houses and shops which were four lanes across the highway, left only small pieces of the SVBIEDs solid engine block, and a 6 foot crater in the highway. Besides killing 20-25 people.

The Platoon leader who saw the explosion go off, said that the flame and blast consumed the husky totally. Once the smoke and flames cleared the driver pulled the husky out of the kill zone. The blast was equal to approximately 500lbs.

The only damage found was some minor bends on the front fender, a few tiny cracks in the glass, and a damaged camera that was mounted at the end of the arm.

THIS IS THE BEST VEHICLE WE HAVE....PERIOD.

I would put my life on the value of the HUSKY.

According to UN estimates, there are at least 110 million active mines scattered in 78 countries, of which about 44 million have been planted on the African continent. In addition to the obvious dangers to life and limb, landmines have a devastating impact on local economic development where vast tracts of land are never utilised, roads are not used and communities are forced to relocate out of fear of the dangers lurking beneath the soil. While relatively easy to plant, the cleanup of mines – whether in larger fields or individual – is difficult and technologically challenging. Hunting for landmines is never an easy task at the best of times, less so in Africa where there are challenges uniquely difficult to this continent.

Landmine-clearing

The logistics of getting vehicles and equipment into Africa is sometimes a real challenge often caused by corrupt governments, political interference or rebel forces. Then, once on the ground, the terrain in most parts of Africa is difficult and harsh, resulting in damage to vehicles and equipment. Finally, Africa has the dubious record for the most minefields that have not been properly recorded and a large number of nuisance mines which litter the continent.

How best to address these challenges? The answer is having people on the ground who understand African conditions with vehicles and equipment specifically designed to operate in such environments. One such company is South Africa's Mechem that has a long history of research and development of mechanical and chemical technology for the defence industry. In 1991 Mechem formed a mineclearing division and is currently the only African company accredited by the UN for landmine clearance.

South African Mechem explosive experts, technicians and trained sniffer dogs work in various parts of the world and across Africa where they support the United Nations and African Union peacekeeping operations clearing large swathes of territory of life-threatening landmines and explosive devices.

Supporting the UN operations in South Sudan, Mechem cleared more than 9 000 km of roads and removed some 3 300 explosive devices prior to the referendum on independence in late 2010.

Mine-clearing operations are painstaking and highly dangerous. While modern technology and sniffer dogs help to detect the presence of mines, in most instances the lifting and disposal of the mines have to be done manually.

Mechem teams normally consist of four multi-task clearance teams, two manual mine-clearance teams, two mine-detection dog teams and one mechanical-clearance team. The mine-clearing teams travel in the South African-designed mine-resistant vehicles, mostly variants of the Casspir and Rhino.

Seen below is the Casspir fitted with steel wheels clearing landmines in Afghanistan.

Chapter 9

UNUSUAL SOUTH AFRICAN MINE-PROTECTED VEHICLES

The initial emphasis in developing of mine-protected vehicles was on armoured personnel carriers, liaison vehicles, ambulances, recovery and logistic vehicles. The SA Army soon realised, however, that the nature of the theatre would also render other vehicles vulnerable to mines: a large theatre with no set front line or safe rear areas, and that required movement over extended distances but was also characterised by few roads, most of them gravel or just tracks; and few river crossings meant that vehicle movement was to an extent predictable and therefore vulnerable to mines. This led to the requirement to provide mine-protection across the range of army vehicles.

Among those based on mine-protected trucks were the Ystervark 20 mm and Bosvark twin 23 mm self-propelled anti-aircraft guns, respectively on a mine-protected SAMIL-20 and a twin-cab SAMIL-100 Kwêvoël, the Bateleur 127 mm multiple rocket launcher, also on a mine-protected twin-cab SAMIL-100 Kwêvoël and specialised engineer and technical services trucks, such as the trackway layer and the Bulperd recovery vehicle. Other vehicles were provided with armoured and mine-protected cabs, among them the Vlakvark combat engineer tractor, the Leguan bridge-layer and various road graders. Yet others were developed to include mine protection in a more conventional design, among them the Rooikat armoured car and the G-6, while the new Badger infantry combat vehicle incorporated new ‘flat bottom’ mine-protection technology. Perhaps the most unusual was the Bospadda locomotive.

These two armoured trains are believed to be a world first. Developed by the South African Railways and Harbours (SAR&H) in 1978 with some clever South African design ingenuity, these armoured trains were equally at home on rail or road. This vehicle had two sets of wheels that it could use for either road or railway track.

Mine-protected Armoured Train

BOSPADDA

When the armoured train was driven from the road and into place above the railway lines, the iron train wheels could be lowered with a lever from the cockpit. Similarly, the rubber tyres were then lifted to hang in a storage position whilst the iron train wheels fitted snugly into place onto the railway line that allowed the armoured car to convert to an armoured train and remain safely on the track.

During times of escalating civil unrest in the mid-1970s, the SAR&H had found it difficult to inspect and repair their railway lines, disrupting their ability to provide safe travel to those who relied on and trusted the SAR&H for transport within their neighborhoods and to and from their place of work.

During those days, the SAR&H utilised open carriages, called ‘ghost trains’, to carry railway policemen and technical staff for many kilometres of railwayline inspection trips. Those open carriages provided minimal protection for the occupants against hand-thrown objects and were not bulletproof. They were confined to the track and were dependent on overhead electricity. The SAR&H decided that something had to be done.

That something resulted in this versatile multi purpose armoured train which allowed the SAR&H to effectively protect their property and to ensure that an effective train service operated, even during times of riots and other irregularities. They were also able to, more

effectively, inspect their railway tracks and equipment.

Together with members of the SA Army and the CSIR, the SAR&H engineers and technicians designed and manufactured around 6 800 parts at specific SAR&H workshops. The armoured trains were eventually assembled at the Road Vehicle Mechanical Workshop of the SAR&H at Langlaagte under the supervision of the works manager, Chris van der Merwe.

The armoured train was equipped with a six-cylinder diesel engine. It was able to reach speeds on the road or rail in excess of 60 km/h whilst it could travel 750 km on one tank of diesel.

SAS

It is understood that these armoured trains could withstand blasts of 7 kg TNT which would ensure the survivability of the driver and occupants on either track or road.

These trains were called *Bospadda*, Afrikaans for bush frogs.

With the first public appearance of these two armoured trains in 1978, the name of the general manager, *Kobus*, was neatly painted on one, while the other had *Chris* painted on its side – named after the works manager. To this day both vehicles are referred to as either *Kobus* or *Chris*.

For the SAR&H it was a matter of great pride that their engineers and technicians could design and build from scratch, in their workshops, such a unique train, a design that was the first of its kind in the world.

Kobus was used as an armoured train in SWA during the mid-1980s for a short while without incident.

Kobus is plinthed on display outside the Windhoek station, Namibia in its original nutria

colouring and SAR&H markings. *Chris* was restored and repainted in the early 1990s by the Metro Rail in yellow and grey and stored in a railway shed in Pretoria.

The designation *Skroopkot*, Afrikaans for the scraping cat, was used for the mine-protected conversions of the Galion road graders used in SWA in the early 1980s. These were most likely the first landmine-protected graders used anywhere worldwide. Some 20 road graders were converted. Seen on the left is, in 1983, a SWA operator travelling alone in a landmine-protected grader on the way to a remote site, towing his caravan.

Landmine-protected
ROAD GRADER

In the 1990s, Mechem developed a mine-protected cabin designed to be fitted onto a road grader, keeping the operator safe from the effects of an anti-tank landmine blast. This mine-protected grader provides flexibility during road-clearance operations in areas suspected of containing landmines, especially during the emergency phase of peacekeeping operations where rapid road rehabilitation needs to be done. This vehicle is fitted with rippers in the front, enabling it to expose sub-surface objects up to a depth of 400 mm.

DRESSER

THE VLAKVARK

The Vlakvark engineer battle tractor is a landmine-protected multi-purpose vehicle used by the combat engineers. It can be fitted with different attachments to allow its use as an excavator, front-end loader, back-hoe or forklift. In its earthmoving guise it can be used to prepare a battlefield by creating or enhancing obstacles and clearing fire lanes, clear rubble off a road, or to create a river or ravine crossing point. Fitted with its forklift attachment, it is used to move parts of the medium girder bridge and can also be used to unload bulk cargo.

Vlakvark is the Afrikaans word for a warthog.

SPECIFICATIONS

Dimensions:	
Length	7 056 m
Width	2 356 m
Mass:	
GVM	24 000 kg
Performance:	
Top speed on road	75 km
Off road	40 km
Fuel tank capacity	600 litres
Range	600 km
Engine:	
V 12 Deutz 4-stroke diesel engine (direct injection), air cooled.	
Gear box:	
ZF Automatic, 4 forward and 1 reverse.	

The Ystervark was the SADF's response to meet the growing need for a light, mobile, modern, self-propelled, anti-aircraft gun to protect its air bases in SWA and to provide some form of anti-aircraft protection of its forces in Angola. The Ystervark was a SAMIL-20 chassis fitted with a full length mine-protected hull which had a much higher and beefier suspension than the basic SAMIL-20 truck, leading to better cross-country performance.

YSTERVARK

It had a GAI-C01 20 mm antiaircraft gun fitted to the load bed. The gun was basically an updated version of the GAI-B01 20 mm gun, capable of 1 050 rounds per minute. The 20 mm gun was fitted with a Delta IV reflector sight which could be set for targets with speeds between 200 km/h and 900 km/h and could be illuminated at night.

It was deployed in combat in Angola during Operations Modular, Hooper and Excite where it proved to be effective in keeping the Angolan- and Cubanpiloted MiGs, flying at high altitudes and on one occasion even accounting for shooting down a MiG. On 17 March 1988, Ernesto Chavez, a Cuban pilot, was shot down and killed by an Ystervark while flying a MiG-23 ML over Cuito Cuanavale.

The sides of the fighting compartment were droppable if necessary, but the fighting compartment had no overhead protection.

After the Border War came to an end, the Ystervark was eventually phased out and replaced with a new twin 23 mm gun, a ZSU 23-2 fitted to a SAMIL-100 Kwêvoël mine-protected truck called the Bosvark, see page 59.

SPECIFICATIONS

Crew:	2
Armament:	
1x20 mm GAI-COI 20-mm AA gun	
Combat mass:	7.7 tons
Fuel:	200 litres
Road speed:	93 km/h
Road range:	950 km

Development work began in the mid-1980s on a 127 mm multi-rocket launch system known as the Bateleur. By the time the SA Army took delivery of the Bateluer in 1989, the conflict in southern Angola had come to an end. It is based on the SAMIL-100 Kwevoel chassis. The Bateleur MRL has 40 tubes with a sea-level range from 7.5 km to 36 km. It can be fired singly or using ripple fire, firing one rocket per second. Reloading time is less than ten minutes. Two stabilisers are fitted at the rear and lowered into place before firing. The SA Army has 51 Bateleurs which are operated by SA Artillery. The Bateleur is named after an eagle found in South Africa. For more information see page 56.

BATELEUR

SPECIFICATIONS

Crew:	1 +4
Dimensions:	
Length	9 950 mm
Width	2 450 mm
Height	3 125 mm
Wheel base	5 940 mm
Ground clearance	355 mm
Mass:	
Tare	9.5 m
Payload	12m
GVM	21.5 m
Performance:	
Top speed	90 km/h
Range	1 000 km

Engine:

V10 15.95 litre air-cooled 4-stroke direct injection diesel generating 268 hp @ 2 650 rpm.

Transmission:

ZF 56-65 synchromesh

The G-6 is a South African-developed three-axle, six-wheeled self-propelled howitzer artillery piece. It is an agile super-range weapon that forms the backbone of a fully integrated and flexible SA Army artillery system. The G-6 is obviously not an armoured personnel carrier but has been included in this book because, like all of the South African-designed combat vehicles, it is protected against landmines.

Self-propelled 155 mm gun/howitzer
G-6

Two and a half decades after it astonished the global defence community, South Africa's G-6 self-propelled gun-howitzer still sets the standards against which all long-distance artillery is measured in terms of mobility, range and accuracy.

Development of the G-6 self-propelled gun-howitzer began in late 1970s with the first G-6 prototype completed in 1981 and the first advanced development vehicle completed in 1994. Before it even went into full production, the G-6 saw action in Angola in December 1987 during Operation Modular. Three prototype/pre-production guns proving remarkably resilient and tough, moving from Potchefstroom around Botswana and up to Rundu under their own power and then along sand trails to Mavinga. From there cross-country – and used to bush-break a new supply route during their move to the front and again on their withdrawal – and then operating non-stop for about a month, firing long-range shoots every day with minimal technical support. The production G-6 entered service a year later with the SADF.

The G-6 was developed from scratch around the ordnance and ammunition family of the G-5, making it one of the world's most powerful, self-propelled howitzer artillery equipment on a wheeled chassis.

The G-6 offers protection against counter-battery fire and its mobility, to shoot-and-scoot, makes it an extremely difficult target to locate and hit. The armoured turret and hull provide protection against small-arms fire and shell splinters while the chassis can withstand multiple landmine explosions. Additionally, the shape and armour thickness of the chassis hull allows it to withstand at least three mine detonations (against TM46-anti-tank landmineor equivalent) before being immobilized. The G-6 is served by a crew of between three and five which includes the driver, commander, gun layer, ammunition loader and breech operator. The on-board gyro-controlled navigation system enables the gun to be brought into action within 60 seconds of stopping and it can move off within 30 seconds after firing. The rate of fire is six rounds per minute.

In September 2001, the G-6 achieved a range of 53.6 km, and ranges of 70 km have since been achieved, using the new velocity-enhanced long-range projectile (V-LAP) and the new M64 bi-modular charge system. V-LAP combines base-bleed and rocket-motor technology, while the M64 charge system increases muzzle velocity to 910 m/s. VLAP is part of Denel's new Assegai range of 155 mm ammunition. All the ammunition for the G-6 has been developed in South Africa and supplied by Rheinmetall Denel Munition.

SPECIFICATIONS

Dimensions:	
Length with gun forward	9.2 m
Width	3.4 m
Height	3.3 m

Mass:	
Weight	37 tons

Performance:	
Road speed	90 km/h
Off-road speed	30-40 km/h
Road range	700 km
Gradient	18%
Turning circle	12.5 m
Side slope	13.5°
Trench	1.5 m
Ford	1 m

Protection Levels:

Ballistic – against 7.62x51 mm AP from 30 m. Frontal protection against 14.5mm HMG fire from 1 000 m at an angle of 30°. Landmines – against TM-46 or 5.7 kg TNT under any wheel. (Note that this is less than the 7 kg of TNT (TM-57) a Casspir can absorb.

NBC – can be fitted if reguired.

Engine:

Air-cooled diesel, delivering 410 kW

Transmission:

Automatic with manual overdrive, 6 forward and 1 reverse gear, selectable 6x4 or 6x6 drive.

Suspension:

Fully independent swing arm with torsion bars.

Brakes:

Flydro-pneumatic service and crawl brakes; mechanical parking brake.

Auxiliary Power Unit:

A45-hp (34 kW) engine provides power for turret operations, recharging the batteries, and the driver/crew compartment air conditioning system when the main power plant is shut down.

Ordnance

Type — 155 mm tube identical to the G-5 but fitted with a fume extractor.

Elevation range-5° to 75°

Traverse-80°

Range – 70 km has been achieved with base bleed and upgraded ammunition.

Ammunition:

47 projectiles (16 in vehicle front, 31 in fighting compartment).

50 charges

64 primers and fuses

G-6 uses the same ammunition family as the G-5.

As in the case of the Ratel ICV, the choice of wheels by the South Africans, rather than tracks, was made after detailed consideration of the likely nature of operations and terrain of the theatre. Wheels grant the vehicle strategic mobility independent of heavy transporters

or trains. The distances in southern Africa are also too great for any tracked vehicle to have the mobility demanded by the highly flexible, fast-moving operational style of the SA Army. Fortunately this fact goes hand in hand with terrain which allows wheeled vehicles good off-road and cross-country mobility.

It's worth noting that other advantages of wheels over tracks which the SADF and Armscor found attractive are: 40 – 60% lower vehicle costs; a service life three times as long; 60% lower fuel consumption; and intervals between maintenance doubled or even trebled. Another advantage of the wheeled vehicle is that it requires half the power of a tracked vehicle of the same weight to achieve a given performance. Above all, however, it was the far greater operational and tactical mobility of the wheeled vehicle that decided the day.

The G-6 made its operational debut during Operation Modular in southern Angola in December 1987. South African artillery observers working behind enemy lines immediately exploited any targets which presented themselves, making full use of the howitzer's pinpoint accuracy. On one such occasion when the Cubans wanted to launch an air strike from the Angolan airfield at Cuito Cuanavale, artillery observers called for G-6 fire support and destroyed four Russian MiG-21 jet fighters as they taxied for takeoff.

The SA Army has 43 G-6s while the United Arab Emirates has 78 systems and Oman 24 systems. In the South African military nomenclature the G-6 is referred to as the Rhino.

Chapter 10

PROVING THE CONCEPT

One thing that the South African armaments acquisition agency Armscor recognised early on, is that it is all very well to develop vehicles and equipment, but they should also be tested against some standard to verify that they meet the requirement and the specification. That led to the establishment of a series of test, evaluation and validation facilities that are still used for this purpose and which have since also become internationally accepted in their roles.

One such facility is the Gerotek vehicle test centre, which focuses on mobility and reliability trials of vehicles being proposed to the SA Army, Special Forces or Military Health Services, but which also includes test facilities addressing other aspects, such as the electrical and electronic equipment installed in combat vehicles and electro-magnetic interference among antennas on combat vehicles. Its carefully designed test tracks and stations are complemented by extended mobility and reliability tests at the Army's Lohatla Combat Training Centre and at the Alkantpan Artillery Test and Evaluation Range, which offers areas of deep sand for specific mobility trials. Mine-protection development and verification tests are conducted at the Paardefontein test site, which is managed by Gerotek.

All South African-designed and -manufactured landmine-protected vehicles undergo a stringent series of blast tests to ensure that their landmine protection levels are independently verified in accordance with an internationally accepted test standard. Who does this testing, what is involved and how is this verification carried out?

Landmine-protected Vehicles

Blast Testing and Verification

The principal CSIR scientist responsible for overseeing these validation tests, David Reinecke, explains:

South Africa currently applies two open (accessible, within reason, to all stakeholders) test standards for vehicle landmine protection: the South African and NATO test standards, called RSA-MIL-STD-37 Issue 3 and AEP-55 Volume 2 Edition 1. South Africa was the first to issue an open test standard in 2000; Issue 3 signifies that it has been updated three times. The NATO test standard was issued in September 2006.

The National Authority Team

The CSIR's landward sciences research area, operated in partnership with Armscor, is the South African National Test Authority with respect to vehicle validation testing. Validation testing is different from certification testing in that the latter is more expensive as it requires a very specific, fully equipped vehicle.

The CSIR is responsible for executing independent validation tests that include all planning, management and technical activities as well as the final report. As such, the CSIR is the custodian of the test standard and the equipment required to execute validation tests, while Armscor is responsible for the verification of the test item and compliance to the test standard and test instruction.

Standards Test Methodology: Step by Step

The inputs and sequence required for validation testing are specified by RSA-MIL-STD-37. The validation of the test item involves physical inspection and the evaluation of the protection systems and levels offered. This presentation by the supplier includes computational modelling and test results.

The first step is the verification of the test item and its suitability for blast testing. This is important as the equipment used for these tests is extremely expensive and should be protected as far as possible. The test item should, therefore, be able to withstand the test charge.

The next step is the drafting and approval of the test instruction by the test team. Considerable preparation is necessary prior to the test. For instance, all the surrogate charges must be manufactured and checked, which includes nondestructive testing and ratification by Armscor. All the test equipment and facilities are prepared and the human response equipment is drop tested. These results are compared to previous data as a benchmark, to ensure that the test equipment is functioning correctly.

This data is diverse and is primarily based on Hybrid III crash-test dummies instrumented to measure landmine blast effects.

Other equipment parametres are external and internal (inside the test item) high-speed video and pressure, acceleration, strain and displacement measurement equipment being used. An important aspect is that all transducers used for measurements must be synchronised with the detonation, ensuring the ‘same time’ baseline to enable comparable and correlated data. This emphasises the importance of pre-test preparations.

The two test standards require different approaches. For AEP-55 Volume 2 tests, soil pits are filled with new soil and compacted. The soil characteristics are tested for density and moisture content prior to the test and adjusted to meet the requirements. RSAMIL-STD-37 tests at the CSIR Detonics, Ballistics and Explosive Laboratory are conducted with a dynamic cone penetrometer (used for measuring the penetrating power of the blast) for consistency.

High-speed video images of a landmine blast

Time 0.

Time: 0.2 milliseconds.

Time: 1.5 milliseconds.

Time: 2.5 milliseconds.

Time: 5.5 milliseconds.

Once the test set-up is approved, an initial booster test using approximately 200 g of explosive is executed to ensure that all equipment is functioning and that all critical human response parametres are being measured.

Additional booster tests are conducted prior to the main test. This cautious approach is required because validation tests are by nature destructive, the test items are expensive to manufacture, and it is crucial that data be captured correctly.

After the booster test the main test is executed with the specified surrogate charge. Only once the test area is declared safe, is the test team allowed forward and the required test data downloaded and analysed. This verifies that all required data has been captured and assists the team with the damage inspection. All items destroyed or damaged are recorded along with the crater dimensions.

Vehicle damage assessment is a requirement of the AEP-55 Volume 2 tests. On completion of the damage assessment, the test item is either removed or repaired by the supplier at the range; these tests do not require the team's presence during the repair process.

A full repairability evaluation in the presence of and in conjunction with the responsible defence force personnel is a requirement of RSA-MIL-STD-37 tests. The test item is removed and repaired offsite with the test team present.

After the repairs, the test item is inspected and verified as safe to continue by the test team. All repairs executed are recorded and a second test is conducted.

Subsequently, the test data is reviewed and all critical parametres are compared to other measured data to verify the results and ensure that there are no anomalies between measurement equipment. It is important that visual (video and inspection photographs) and other data, such as pressure or force, correlate.

The compilation, review and finalisation of the test report follow next. RSA-MIL-STD-37 test data is evaluated and recommendations are made to improve and enhance the survivability and repairability of the vehicle. After the report is approved and the item has passed, the RSA-MIL-STD-37 officer in Armscor requests the organisation to issue validation test certificates. AEP-55 Volume 2 tests are not strictly independent and recommendations are not mandatory.

Future Research

Current testing standards are not perfect, and require constant research and updating to ensure that the best possible methodology is used. Some criteria, such as those used for the lower leg of occupants, are heavily disputed, the latter being one the main reasons that vehicles fail to satisfy.

The CSIR's landwards sciences experts form part of the NATO Research and Technology Organisation's Panel Task Group 148, responsible for updating AEP-55 Volume 2 test standards and developing AEP-55 Volume 3. The latter is the test standard for protection levels of vehicles against improvised explosive devices (IEDs). As part of this NATO initiative and in response to future research requirements, scientists are researching the effects of blast IEDs on vehicles. This is primarily focused on scaled testing, but will be further developed to update RSA-MILSTD-37.

The scientifically instrumented impulse measuring apparatus (SIIMA) was developed to research various parametres that affect blast loading (i.e. the pressure/force and impulse applied). It enables the landmine threat to be characterised and surrogate mines to be developed and qualified. SIIMA takes all close field explosive effects into account in measuring the total blast impulse of a charge. Current areas of research are the effect of the steel pot vs. buried charges (a repeatable scientific representation of the mine), the depth of burial and the effect of moisture content in the soil on the blast impulse and

ultimately, the vehicle.

Although extensive research has been executed about blast effects on human beings, no standard surrogate or test method has been developed for validating demining and personal protective equipment systems for explosives disposal. The results of this research can be used to validate current pressure criteria and enable protection systems to be developed for blast pressure. This is of particular importance to IED testing and injury criteria.

With the wide variety of South African-developed military vehicles being manufactured to international standards, it begs the questions, ‘how are they evaluated?’ and ‘where are they all tested?’ During the late 1970s, with the UN-led international arms embargo against South Africa in full swing, it was clear that the country would have to go it alone in equipping its defence force with locally developed and manufactured military equipment. One of the primary requirements was military vehicles.

South Africa’s Premier Vehicle Proving Ground

GEROTEK

With the Armscor head office, CSIR, many military vehicle manufacturers and the SADF headquarters all based in Pretoria, it made sense to set up a test site within easy reach.

A 550-ha site located 20 km outside Pretoria was found and developed into what has become a world-class vehicle design and evaluation proving ground. The initial capability was established to serve the need to test military vehicles for compliance to military requirements. In time this has been opened to the civilian market, providing over 20 unique vehicle testing tracks and an internationally accredited ISO 17025 product test laboratory where vehicles and products are put through their paces for approval to comply with local or international standards for use in southern Africa and international markets.

The name given to this test track, Gerotek, are derived from *Gero*, Ancient Greek for excellence in testing. *Tek* is Afrikaans for test and evaluation. The *K* is kundigheid, Afrikaans for science.

The test facilities at Gerotek encompass virtually all driving conditions to be found in southern Africa, accommodating vehicles from passenger cars, four-wheel drives to heavy trucks and of course a wide range of specialised military vehicles.

Other unique test tracks include a high-speed oval, off-road tracks and a 4x4 rough track, a fording facility, suspension track, a side-slope, a dynamic circular track to evaluate the wet handling characteristics of light vehicles and tyres, a gradient and suspension track, rocky terrain, and approach and departure angle tracks, to mention a few.

Other roads and sites include a series of gravel and dirt surfaces designed specifically to test road and in-cabin noise, suspension, braking and traction control systems, dust entry, cooling systems, chassis durability for trucks, and many other aspects of vehicle performance.

Seen below are Springbuck Mk Vs being put through their paces on the suspension test track.

The gradients are a series of steep inclines and declines that are used to determine

whether vehicles meet the specified grading requirements under standard conditions while displaying climbing and descending ability. The gradients can also be used to test performance of a vehicle on a specified gradient, the influence of a specified gradient on fuel supply and lubrication, the efficiency of a vehicle's clutch and hand-brake, start and pull-away capabilities against a gradient, the effect of weight displacement and recovery capability.

Gerotek's smooth, horizontal concrete skidpan is the largest in the southern hemisphere. It is pear-shaped and has a 50 m radius. The skidpan is used to perform repeatable and comparative tests to evaluate handling, suspension, steering and tyres under wet and dry standard conditions. A central water cannon, with a spray radius of 30 m, ensures effective water coverage of the skidpan.

Gerotek's sand trough is unique in the fact that the sand has been imported from the Central Kalahari. The genuine Kalahari sand gives clients the opportunity to experience a real-life situation in a controlled environment. The complete sand trough is under cover to control moisture content and to prevent pollution. The sand trough can be used to test vehicle tractive effort on sand, wheel sinkage and slip, rolling resistance and traction and flotation of tyres, performing comparative soft-soil mobility tests on vehicles under repeatable and controlled conditions.

The Gerotek rough track is unique with some outside-the-box thinking. It was designed by taking a typical South African cross-country route with mixed off-road terrain, and then concreting all of the rocks and stones into it, exactly where they found them. This gives an absolutely repeatable off-road test track with every vehicle having to deal with exactly the same track.

The Buffet Mk IIB cargo being put through its paces on the rough track.

The Soedoring undergoing gradient tests in 1981.

Rooikat Prototype Class-1 6x6 being tested on the side slope 1982.

The Rhino undergoing a fording test in 1982.

As the counter-insurgency war intensified in SWA, landmines became more frequently used in SWAPO's hit- and-run tactics; so too did the number of incidents involving SA military vehicles detonating mines.

Landmine Incident Reporting

By the mid-1980s South Africa was the only country in the world developing sophisticated combat-proven landmine-protected vehicles. Their scientists and design engineers had a very active research and development programme that continually looked at ways in which to improve the occupant safety that would reduce the injuries from under-body explosions of landmines.

Obtaining data from the field was important. After each landmine incident a report had to be completed that would provide useful information for the better understanding by the

researchers into how the vehicles coped with a blast and ways in which improvements could be made. The mine incident report, as seen on the following pages, was often considered by the soldiers in the field as unnecessary paperwork not realising how vital these statistics were to the boffins back in South Africa.

Casspir Mk I front left wheel detonation.

SAMIL-100 Kwêvoël front right wheel detonation.

MAY 82

LEASE PRINT

MINE INCIDENT REPORT NO ..13..

1. Date of incident ..11-5-82..
2. Time of incident ..0900..
3. Place ..52 BN..
4. Grid reference ..WL 693 503..
5. Type of vehicle ..CASSPIR..
6. Registration number ..BDK 692B..
7. Unit operating vehicle ..SAP..
8. Brief description of incident ..CASSPIR RETURNING FROM OSHAKATI DETONATED MINE..

Report completed by:
Number 8341693BG Rank KAPT
Name WH WILLIAMS Signature

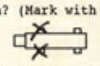
PART I VEHICLE

MARK THE APPROPRIATE BOX WHERE APPLICABLE

9. Estimated speed of vehicle (km/h)

0-9	20-29	40-49
10-19	(30-39)	50

10. Where under the vehicle was the mine detonation? (Mark with a cross)

FRONT 

1. Were tyres water filled? YES [X]
2. Were Barber plates fitted to the vehicle? YES [X]
3. Where on the vehicle were Barber Plates fitted? —
4. Were sandbags used? YES [X]
5. Where on the vehicle were sandbags placed? —
6. Were any other protective measures used? Describe. —
7. Were seat-belts fitted for all occupants? [X] NO
8. If answer to 17 was 'No', why not? ....

19. Position number in convoy from lead vehicle? ..1..
20. What other vehicles were proceeding? List in order ..3X CASSPIRS..
21. Has the vehicle been photographed? [X] NO
22. Who took photographs? (Number, rank, name) ..SAP..
23. Where are the negatives? ..SAP - OSHAKATI..
24. Briefly describe mine damage to vehicle (Technical reports to be attached) ..FRONT SUSPENSION DESTROYED..
25. Was a fire started? YES [X]
26. Cause of fire if known —
27. Where on the vehicle did fire begin? —
28. What was the extent of the fire? —
29. Position of the vehicle after detonation:

ON ROOF	ON LEFT SIDE	ON RIGHT SIDE	ON WHEELS
[ ]	[ ]	[ ]	[X]

30. Brief details of movement of vehicle after detonation: ..LIFTED INTO AIR, CAME DOWN NEAR GATE..

PART II PERSONNEL

31. Total number of passengers including driver ..9..
32. The vehicle is represented diagramtically below. The driver's seat position in No 1. Each seat is denoted by a square divided into four. This diagram is to be filled in as follows for each seat:

3

1	2
3	4

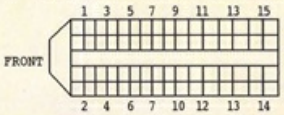
TYPICAL SEAT

(a) In Position 1 place a:
Y - if a seatbelt was fitted to this seat
N - if a seatbelt was not fitted

(b) In position 2 place a:
X - if the seat was unoccupied
Y - if the seatbelt was worn by the occuplant
N - if the seatbelt was not worn

(c) In position 3 place a:
X - if the seat was unoccupied
K - if the occupant was killed
S - if the occupant was seriously injured
M - if the occupant suffered minor injuries
U - if the occupant was unhurt

(d) In position 4 place a:
Y - if the metal support for the seat was bent (remove seat to inspect)
N - if the metal support was undamaged.



PLAN OF SEATS IN VEHICLE (Driver is No 1)

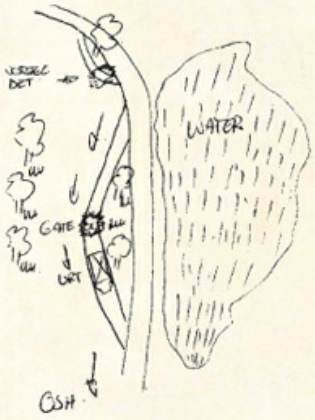
33. If metal seat supports for any seat were bent, give the seat number, describe bending and give a measurement of the deflection:

Seat No	Damage	Deflection measurement

34. Details are required of all persons injured or killed. Fill in the table below. Under 'cause' answer blast shrapnel, fire, ambush, accident etc. The seating position number is obtained from the plan in par 32 the driver is number 1.
NB
A copy of the post mortem or injury report is to be attached.

Number	Rank	Name	Cause	Describe injury inflicted	Seat position
				NO ONE INJURED	

35. In space below sketch the scene of the incident, include:
(a) Position of the vehicle after blast
(b) Position of anti tank mine (mark with a 0)
(c) Relative position of any A P Mine (marke with a X)
(d) Any landmarks eg large trees, bridges, cattle girds, old mine blast holes etc.
(e) Measurements of
(i) Road width 5m
(ii) Distance from edge of road to mine IN TRACKS
(iii) Distance between A T mines and A P mines 0
(iv) Distance from blast point to vehicle 6m
(v) Distance from vehicle to persons thrown out of vehicle 10m
(vi) Any other measurements of interest. —



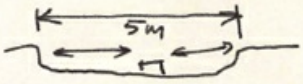
PART III - MINE

36. Was mine [DETECTED] → [DETONATED]

37. If detected : How was mine detected
[VISUAL] [MMD 3] [MMD 4] [PRODDER] [OTHER]
Other describe .....

38. Dimensions of crater ..5m x 0.75m

39. Sketch crater in space below:



40. Type of soil around crater ..... HARD SAND

41. Position of soil from the crater
..AROUND....CRATER..

42. Type and number of AT mines 2..

43. Material found identifying type of mine .....
NO METAL

44. How certain are you of the mine type used? [Positive] [Almost sure] [Not sure]

45. Was the mine boosted? [Yes] [No] [Not sure]
TMA-3

46. Give type and number of any AP mines found in the vicinity: ..0.....

47. Did an ambush -
(a) precede, [ ]
(b) accompany, or [ ]
(c) follow the detonation [ ]
(d) was no ambush [X]

48. Describe damage caused by ambush .....

49. Was mine placed:
On a level road [X] On a corner [ ]
At a cross roads [ ] In a dip [ ]
On a rise [ ] On a road fork [ ]
Other, describe .....

50. Was the position of mine marked? [Yes] [X]

51. Describe marking:
Stones [ ] Pile of soil [ ]
Bent bushes [ ] Other method [ ]
In other describe .....

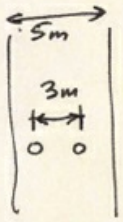
52. Road type:
Tar [ ] Soft [ ] Wet [ ]
Gravel [ ] Sand [X] Dry [X]
Hard [ ] Track [ ]

53. Give details of mines .....

54. Was:
(a) An anti-lift fitted [Yes] [X]
(b) The mine booby trapped in any Other way [Yes] [X]
If any describe: .....

55. Give details of initiation systems used ...PRESSURE.....

56. Make a sketch below of method used in laying of the mine/s. Include distances from road edge to mine, total road width and distances between mines.
Mark anti tank mines with a O
Mark anti personnel mines with a X



57. Use this space for notes:

- THERE WERE 5 TRACKS FOUND IN THE VICINITY OF THE MINE BLAST
- FOLLOW UP ACTION INITIATED
- IN FEB A BUFFEL HIT A MINE IN THE SAME AREA
- NO SERIOUS INJURY
- NO INSURGENTS FOUND

INSTRUCTIONS: This report must be completed for all incidents where mines explosives or ammunition was used for attack aimed against vehicles, roads, bridges, aeroplanes and airports or landing strips whether detonated or detected.
To be completed for mines detected.

Chapter

SOUTH AFRICAN INFLUENCE ON MRAP VEHICLES INTERNATIONALLY

11

The wars in Iraq and Afghanistan saw improvised explosive devices (IEDs) become a favoured guerrilla weapon: in Afghanistan IED attacks went from 81 in 2003 to 7 228 in 2009, and by early 2008 IEDs were causing 80 percent of US casualties. By November 2008 that was down to 5 percent. That difference was a result of the growing numbers of mine-protected and mine-resistant, ambush-protected (MRAP) vehicles – despite deliberate targeting of these vehicles.

In 2011 the Pentagon estimated that MRAPs had saved 30 000 lives in Afghanistan and 10 000 in Iraq, and by 2012 there were 12 000 deployed of 27 000 ordered for $50 billion. Specific analyses also show the difference they made:a 2011 report by the Congressional Research Service, showed a fatality rate for armoured HMMWVs of 22 percent; that for M1 Abrams tanks was 15 percent; that for attacks on MRAPs was 6 percent.

South African Technology Abroad

The mine-protected and mine-detection vehicles were not the first time South Africans led in the fight against landmines. During World War II two South African officers developed the idea of a rotating chain flail system mounted on a tank to flay a minefield and detonate any mines in front of the vehicle.

A test rig was constructed in South Africa where the results were so encouraging that the design was taken to England where it was developed further. The flail tanks became one of the ‘funnies’ of the British Army, and the flail concept is back in use today for de-mining purposes.

The first spin-off from the mine-protected vehicles was the Wolf, developed in 1983 by Windhoek Maschinenfabrik for the SWA Police COIN unit. The prototype was built in three months, and the new vehicle went into production in 1984. It used the same monocoque V-hull concept as the Casspir but with MAN components, and considerably more power (264 kW), higher speed (120 km/h) and greater range (2 000 km). It had a dual 12.7/7.62 mm mounting on the roof, a ‘bow gun) a machine gun at each rear corner, and five ball mountings in each side and one in each half of the rear door for machine guns. The side-firing guns were dropped in later vehicles.

Sherman tank with the South African-designed flail attachment.

Wolf.

Sterk Hans 6x6 recovery vehicle.

Strand Wolf.

In addition to the Wolf APC, some Strand Wolf logistic vehicles with a mine-protected cab were also built, as well as a single 6x6 recovery vehicle that was the first 6x6 monocoque mine-protected vehicle built anywhere.

In 1993 WMF developed the 10 ton WerWolf for the Namibian Army, which combined a V-shaped mine-protected hull and fixed armoured cab with a modular rear body. Several modules were developed for use as an armoured personnel carrier module, a truck and a platform for a twin 23 mm anti-aircraft cannon. A high-body version was developed for humanitarian de-mining organisations. The WerWolf can reach 125 km/h and has a range of 960 km. Its armour protects against small-arms fire, a 14 kg IED at 3 m, and a triple mine under any wheel or a double mine under the hull itself.

The South African mine-protected vehicles developed from the 1970s onwards have had considerable influence internationally, from South African vehicles being bought by other armed forces, through vehicles being designed in South Africa for other countries, to South Africans being part of design teams in other countries and, finally, to the adoption of the basic concepts by designers in other elsewhere.

Perhaps the first country to buy mine-protected vehicles from South Africa was Sri Lanka. In the mid-1980s the Sri Lankan Army faced a landmine threat similar to that faced by the South African Army along the Angolan border. The arms embargo notwithstanding, the Sri Lankan Army bought a number of Buffel mine-protected APCs in 1985, naming them

Buffalo. The Army's Electrical and Mechanical Engineering corps (SLEME) then took the Buffel as a basis and developed a unitary-body, right-hand-drive version called the Unicorn, which was in production until 2000, when it was followed by a new design, the Unibuffel, which has an enclosed troop compartment with ring-bearings at front and back for machine guns. Later the Sri Lankan Navy mounted the Israeli Typhoon 25 mm cannon system on the back of a flat-bed version of the Unibuffel as a port defence weapon.

A small number of Buffel APCs were also acquired by Uganda somewhat later, seeing service in operations against the Lord's Resistance Army and being employed together with Eland-90 armoured cars in operations reminiscent of South African operations in southern Angola.

The Buffel and the Casspir also provided several armies with their first experience of vehicles of this type during the operations of the UN Transition Assistance Group (UNTAG) along the border between Namibia and Angola in 1989. SA Army Buffels and Casspirs were provided to UNTAG, and several Australian Army officers were so impressed that they initiated a process in Australia that finally led to the Bushmaster APC being developed – with the assistance of at least two key South African mine-protected vehicle experts – in that country.

The Unibuffel was developed by the Sri Lankan Electrical and Mechanical Engineers on the basis of the Buffet armoured

personnel carriers imported from South Africa. It is a right-hand-drive vehicle and has an enclosed troop compartment with ring bearings for machine guns front and back.

The newer Casspir drew greater interest and was adopted by the armies and police field forces of 16 nations, among them India (165 refurbished SA Police Casspirs), Indonesia (Special Forces Command), Nepal, Peru (Police) and the United States (68). A substantial number of Casspirs were also used by nongovernmental organisations involved in de-mining. The Casspir was so well received in India that a local vehicle was developed by a joint venture company – Defense Land Systems – established by Mahindra and BAE Land Systems. The Mahindra Mine-Protected Vehicle (MPV-I) has received some bad press, but that has been less than fair as most of the casualties suffered were the result of very large IEDs, not the anti-tank mines it was designed to protect against.

The Mamba has also enjoyed export success in both its original form and in many derivatives, having been used by the forces of some 18 countries as well as the United Nations. It and the Iron Eagle prototype were also taken further by Alvis after it acquired OMC on taking over Vickers in 2002. Alvis engineers revised both designs in the United Kingdom, but both wound up grossly overweight and never entered general service. A number of Alvis 4 and Alvis 8 vehicles were later sold to security contractors.

Meanwhile BAE Systems acquired Alvis and with it the former OMC, now renamed BAE Land Systems South Africa. The OMC engineers had meanwhile been carrying on with their work, incorporating operational experience with the Casspir into the design of the new RG31, and further developing the Mamba concept into the mine-hardened RG32M and the mine-protected RG32LTV.

The Rinkhals armoured and mine-protected ambulance was replaced by the Mfezi in the SA Army service. It is still being manufactured and in use in other countries and humanitarian de-mining organisations.

The Mahindra mine-protected vehicle was developed by BAE Land Systems South Africa OMC as the RG Protector, which could take different power trains and equipment. It is manufactured in India by Mahindra as the MTV-I. Other mine-protected vehicles are offered by Ashok Leyland (based on Paramount's Matador) and Tata.

The Alvis Acorn was developed on the basis of the Iron Eagle that Mechem produced for the SA Army's 44 Parachute Brigade. It became substantially heavier but did see use in the Balkans.

The RG31 became the first of a new vehicle class, mine-resistant, am bush-protected (MRAP), and became familiar on TV screens from its use by US forces in Iraq and later Afghanistan. It has been sold to at least eleven countries, with more than 2 000 being sold to the United States alone, as well as to the United Nations. The RG32 also found buyers, with more than 650 sold to six countries and the UN, and saw service in Afghanistan.

Key elements of the design of these vehicles were then incorporated into the RG33 for General Dynamics in the United States. There it was further developed into the Medium Mine-Protected Vehicle (MMPV) and entered production for the US Army against an order for 2 500 in both 4x4 and RG33L 6x6 variants.

BAE Land Systems South Africa OMC had also acquired the Iguana design from Industrial and Automotive Design (IAD), renaming it the RG34. Originally designed for Sabiex in Belgium, this useful little vehicle has yet to see a similar level of success, but more than 200 have been built under licence in Malaysia.

Meanwhile, other South African companies like Integrated Convoy Protection (ICP, the Reva APC), Ivema (the Gila APC) and OTTTechnologies (the M26 and M36 Pumas) entered the market and also won some useful export orders, ICP exporting more than 600 of its vehicles to Africa, the Middle East and Asia. Later companies like N4Trucks and Paramount entered this market, the latter selling its vehicles to Azerbaijan.

The RG33L was developed by BAE Land Systems OMC in South Africa and then re-engineered in the United States to accept a different power train and with other modifications before going into production for the US Army

Perhaps the most interesting development was that South African engineers began to develop mine-protected vehicles for other countries. The first was Dr Vernon Joynt, the father of most South African vehicles, by then heading up Denel's Mechem division, who developed the Tempest for Technical Solutions Group in the United States, using as a basis Mechem's Libhubesi prototype. The Tempest was acquired in small numbers by the British Army in 2001. Mechem then developed the Lion II for TSG on the basis of his original Casspir design. The Lion II was selected by the US Army in June 2001 as the basis for a mine-protected clearance vehicle. That became the Buffalo, of which 650 were built for the US Army and 83 for other users – and which went on to become a star of the Transformers television series.

The Lion II was developed by Mechem in South Africa who lengthened the protected cab area, added additional route clearing systems and the vehicle became known as the Buffalo.

The Buffalo was developed by Mechem for TSG in the United States, and then ordered by the US Army for its EOD teams.

Mechem's Libhubesi served as the basis for several vehicles, including the Tempest and the Cougar.

The Tempest was developed by Mechem for TSG on the basis of its Libhubesi demonstrator vehicle, and was acquired in small numbers by the British Army. It also served as a stepping stone to the Cougar bought by the US Army and then developed into several variants for the British and Iraqi armies.

Interestingly, the only other candidate for the MPCV programme was another South African vehicle, the Casspir Mk II.

TSG was also developing the lighter Cougar mine-protected vehicle, also based on the Casspir concept but designed to NATO standards. Struggling financially, the company was taken over by new owners and renamed Force Protection in 2002, with Dr Joynt as chief scientist. He and his new team completed the Cougar development in 2004, and more than 4 000 were built for US forces, 685 derivative vehicles for the British Army (Mastiff, Ridgeback and Wolfhound) and 1 200 of a lighter derivative, the Iraqi Light Armoured Vehicle (ILAV) for the Iraqi Army, as well as a small number for Yemen.

The next major project was the lighter and more agile Ocelot, which was further developed by Force Protection Europe and Ricardo, a British engineering design company, to become the British Army's Foxhound 'light protected patrol vehicle', with 325 ordered by December 2011.

A Force Protection Cougar used by a US Army EOD team, fitted with an extensive communications suite and a mast-mounted TV camera.

The British Army's new Foxhound protected patrol vehicle is a variant of the Ocelot developed by Force Protection under the guidance of Dr Joynt.

Back in South Africa Land Mobility Technologies, now majority owned by Denel, developed mine-protected truck cabs for the Mercedes Benz Actros and Zetros truck families, the former being selected by the Canadian Army for its Actros trucks. LMT has also developed several bespoke mine-protected vehicles, including a bomb disposal vehicle for a Middle East client, and a mine-and ballistic-protected personnel container for Mercedes Benz that can be loaded onto any large hook-lift truck. The container can be used for personnel transport, as command post or communications centre, or as part of a mobile hospital, being fully self-contained and designed to accept different interior fits. LMT also developed a 'flat-bottom' technology for mine protection, which has gone into the SA Army's new Badger and which has been adopted by Patria in Finland for use in its Armoured Modular Vehcle (AMV), which is the basis of the Badger platform.

The Australian Army's Bushmaster is based on a design by Timoney of Ireland, but its development as an operational mine-protected vehicle was overseen in Australia by two experienced South African engineers.

Meanwhile on the other side of the globe, the Australian Army had selected a vehicle designed by Timoney in Ireland as the basis for the protected mobility vehicle to be acquired under its Project Bushranger. This vehicle was then developed in Australia into the Bushmaster – with at least two South African engineers being brought in to work on the project and apply their experience of the South African programmes. More than 1 000 have been ordered for the Australian Army, and at least another 125 for other forces, including the Netherlands Army.

Mobile Land Systems' Caprivi Mk I mine-protected vehicle served as the basis of a new MPV developed for China.

Perhaps, most surprisingly of all, the South African company Mobile Land Systems, which was established in 2009, has developed a mine-protected vehicle for the large Chinese defence company Poly Technologies. Based on its Caprivi Mk 1 personnel carrier, this has become the CS/VP3 being built by Changan Industries.

THE SINCEREST FORM OF FLATTERY

At the same time as South African companies continued to develop and refine their designs, and companies in other countries have used them as a basis for their own designs or imported South African engineers, other companies have applied the core concepts to improve their own vehicles or developed new vehicles using the same core design concepts.

The German Army's Dingo and Dingo 2 are mine-protected utility and patrol vehicles built on a Unimog chassis.

Among them are companies in at least 16 countries: Colombia, France, Germany, Georgia, Indonesia, Israel, Italy, Poland, Russia, Serbia, Singapore, Thailand, Turkey, Ukraine, the United States and the United Arab Emirates. The vehicles range from light patrol vehicles, that may not be as mine-protected as they look, through to armoured and mine-protected utility vehicles and trucks still using a chassis, to modern monocoque scout cars and infantry combat vehicles.

A new design has been developed by KMW in Germany applying the core concepts, the notion of keeping the wheels as far from the crew as possible, and a remarkable degree of modularity. The 'geschütztes fahrzeug system' (protected vehicle system) comprises front and rear axle modules, a power module that can be mounted in the front or back of the vehicle, and various mission modules.

Finally there have been various efforts to develop a mobile mine- and IED-detection system such as the South African Chubby, none of them particularly successful as yet.

Something of a 'halfway house' design is Serbia's Lazar ICV, impressive-looking but still using a chassis. It has been acquired by Kenya.

Rheinmetall's GeFaS concept vehicle takes several ideas further, including complete modularity and placing the wheels far out on the corners.

The Sovim 2 mine-detection vehicle was developed by MBDA to meet the same requirement as the Husky, but has not entered service.

ZF
3

Glossary

ADE – Atlantis Diesel Engineering was a South African manufacturer of diesel engines and engine components. The company was started in 1979 by the government of South Africa following the imposition of sanctions by the United Nations Security Council. ADE was licensed in 1979 to manufacture Mercedes Benz and Perkins diesel engines primarily for military vehicles such as the Unimog, Ratel, Buffel, Casspir, Rooikat and SAMIL vehicles.

APC – Armoured Personnel Carrier

APV – Armoured Personnel Vehicle

Armscor – Armaments Corporation of South Africa Ltd; government-owned industry responsible for the manufacture and procurement of armaments;founded in 1976 after amalgamation of the Armaments Board and the Armaments Developments and Manufacturing Corporation.

ARV – Armoured Recovery Vehicle

BSAP – British South Africa Police – the police force of Rhodesia from 1889 until July 1980.

CASSPIR – A mine-protected vehicle named after an anagram of the abbreviations of the South African Police (SAP) and the Council for Scientific and Industrial Research (CSIR).

CDU – Chemical Defence Unit, section of CSIR in the 1970s.

COIN – Counter-insurgency

COTS – Commercial Off The Shelf

CRU – Chemical Research Unit, section of CSIR in the 1970s.

CSIR – Council for Scientific and Industrial Research

CVED – Combat Vehicle Electric Drive demonstrator.

DENEL – Denel Ltd is a South African state-owned aerospace and defence technology conglomerate established in 1991.

DRC – Democratic Republic of the Congo

DRU – Defence Research Unit, section of CSIR in the 1980s.

EAOS – Enhanced Artillery Observation System (for the Ratel).

EOD – Explosive Ordnance Disposal

GVM – Gross Vehicle Mass

IAD – Industrial and Automative Design, a South African-based company.

ICV – Infantry Combat Vehicle

IFV – Infantry Fighting Vehicle

IED – Improvised Explosive Device

Koevoet – South African Police COIN unit;established 1979; operated in SWA with units based at Oshakati (HQ), Opuwa and Rundu. Afrikaans for crowbar; the name originated in the concept that the unit, originally formed as an intelligence-gathering unit, would pry loose'the grip guerrillas had on the civilian population in the border area.

Laager – An all-round protective formation adopted by armoured fighting vehicles and infantry combat vehicles to rest, resupply and maintain their equipment.

LHM – Light High Mobility

LMG – Light Machine Gun

LMT – Land Mobility Technologies

LTV – Light Tactical Vehicle

MCV – Mechanised Combat Vehicle

ME – Middle East

MFF – Mobile Field Force

MiG – Mikoyan-Gurevich; Soviet-designed fighter-bomber jet aircraft

MIV – Motorised Infantry Vehicle

MMDS – Mobile Mine Detection System

MPLA – *Movimento Popular de Libertação de Angola* (People's Movement for the Liberation of Angola)

MPV – Mine-Protected Vehicle

MRAP – Mine Resistant and Ambush Protected

MRLS – Multiple Rocket Launching System

MRV – Maintenance Repair Vehicle

Monocoque – Derived from the Greek *mono* meaning single and the French *coque* meaning shell, and used to describe a self-carrying structure such as an aircraft in which the fuselage skin is the load-bearing structure, rather than using a frame to which the skin is attached. In the case of vehicles it describes a vehicle that does not have a chassis, the body serving as its own chassis, with the driveline attached directly to it.

NATO – North Atlantic Treaty Organisation

NBC – Nuclear, Biological and Chemical

PLAN – People's Liberation Army of Namibia; SWAPO's armed wing

RPU – Recce Patrol Utility

SA – South Africa

SAAF – South African Air Force

SADF – South African Defence Force; formed in 1961 when South Africa became a republic; became SAND in 1994.

SAMIL – South African Military Vehicle

SAMS – South African Medical Services; since renamed SA Military Health Service or SAMHS.

SANDF – South African National Defence Force; was formerly the SADF until 1994. The addition of the word 'National' served to denote the integration of the former Homeland armies and the armed wings of the ANC and PAC with the former SADF.

SAP – South African Police; formed in 1913; became the SAPS in 1994.

SAPS – South African Police Services; formerly the SAP until 1994.

SAR&H – South African Railways and Harbours

SARC – South African Reconnaissance Car

SOCOM – U.S. Special Operations Command

South African Border War – also referred to in South Africa as the Angolan Bush War; was a conflict that took place from 1966 to 1989 largely in South West Africa (now Namibia) and Angola between South Africa and its allied forces (mainly UNITA) on the one side and the Angolan government, SWAPO, and their Soviet-backed allies (mainly Cuba) on the other. It was closely intertwined with the Angolan Civil War and the Namibian War of Independence.

SPAAG – Self-Propelled Anti-Aircraft Gun

SPAAM – Self-Propelled Anti-Aircraft Missile

SPADS – Self-Propelled Air Defence System

STANAG – In NATO a Standardisation Agreement (STANAG) defines processes, procedures, terms, and conditions for common military or technical procedures or equipment between the member countries of the alliance.

SWA – South West Africa, former German colony, occupied by South Africa in 1915 and then administered by South Africa under a League of Nations Mandate from 1915 until the territory became the independent Republic of Namibia on 21 March 1990.

SWAPO – South West Africa People's Organisation that became Namibia's ruling party when the territory gained independence in March 1990.

SWATF – South West Africa Territory Force; formed in 1980.

TAPV – Tactical Armoured Patrol Vehicle

TNT – Trinitrotoluene, explosive material. The explosive yield of TNT is considered to be the measure of strength of bombs and other explosives.

UDF – Union Defence Force; the official designation of the South African armed forces from 1912 until 1957 when it was remaned the South African Defence Force.

UN – United Nations

UNITA – *União National para a Independencia Total de Angola* (The National Union for the Total Independence of Angola)

UNTAG – The United Nations Transition Assistance Group was a United Nations peacekeeping force deployed from April 1989 to March 1990 in Namibia to monitor the peace process and elections there.

USMC – United States Marine Corps

VMMD – Vehicle Mounted Mine Detector

Genealogy of major South African armour companies

TFM manufactured the Casspir and a number of other vehicles forthe SADF and Police from the early 1980s onwards. In mid-1997, the TFM Defence and Security Division together with OMC, Ermetekand Gear Ratio was taken over by the Reumech Group, the former's range of vehicles was integrated into what became Reumech OMC, based in Benoni. The

OMC segment of the name stands forthe Olifant Manufacturing Company (of South Africa), having been originally established specifically forthe task of developing the Olifant tank for the SA Army on the basis of the old Centurions. Reumech also took over the military contracts of Truckmakers.

Following South Africa's re-admittance to the international arena afterthe democratic elections in 1994, a number of foreign defence industry companies expressed significant interest in purchasing the company.

It was Britain's defence group, Vickers Plc that purchased the company (late in 1999), renaming it Vickers OMC. Towards the end of 2002, Alvis Plc took over Vickers Defence Systems and the latter company became known as Alvis Vickers. The South African company of Vickers OMC was part of this deal and this company was renamed Alvis OMC. Late in 2004 Alvis Plc was taken over by BAE Systems and Alvis OMC was renamed BAE Land Systems South Africa OMC. In June 2014 Denel purchased BAE Land Systems South Africa OMC.

Photo credits

SD
SM
SM
SM
SB

Armscor 31-32, 37, 40-42, 48-55, 61-70, 78, 80-82, 87, 88, 91, 166, 168, 169, 175, 183 (bottom), 231 (top), back cover
BAE Land Systems South Africa OMC 5, 116-119, 121-133, 194, 195, front cover
Beetge, Frans 83, 90
Binneman, Dolf 46
Blyth, Geoff 23
Botha, Johannes 81 (top left), 218, 219
Camp, Peter 180 (bottom)
Camp, Sarah 250 (top)
Coetzee, André 199, 210 (bottom), 211
CSIR 228
Davis, Kasey 180 (top)
DCD 4, 136-139, 212-215, 229, 231, 232
Denel Land Systems 198-200
Dicks, Larry 234 (bottom)
Dippenaar, Johan 179
Dovey, John 100, 164, 173
Gerotek 227
Heitman, Helmoed iv, 1, 3, 6, 19, 27, 29, 114 (top), 172 (top), 173 (insert), 187, 236, 238, 247, 249, 250 (bottom)
Heymans, Hennie 39, 234 (top)
Hill, Michael 34
ICP 115, 148-153
Joubert, Koos 7, 28, 36, 38, 52 (top), 68 (bottom left), 71-73, 77 (top left), 79, 85, 86, 89, 91 (bottom), 95 (bottom), 96, 109, 210 (top), 233 (bottom right)
Kritzinger, André 45
Land Mobility Technologies 144-147
Marshal, William 15, 17
Mechem 20, 22, 44, 98, 102, 103, 110, 111, 162, 163, 216, 220, 241 (bottom left), 242 (top left)
Muller, Pieter 30
Natal Carbineers 2 (right)
National Museum of Military History, Johannesburg 11, 12, 14, 16
N4 Trucks 140-143, 230
OTT 160, 161
Paramount 154-158, 196, 197
SA Armour Museum 165, 192, 193
SANDF 43, 103 (bottom), 112, 113, 174, 181, 185, 223-226
SANDF Archives v, 2, 9, 10, 13, 18, 21, 22, 24-26, 27 (inserts), 36 (middle), 47, 59, 60 (top), 69 (bottom right), 84, 99, 167, 170-172, 176, 178, 202-207, 220 (top), 221, 222, 238 (top)
SAPS Museum 26 (insert), 37 (insert)
Segone, Sello 58 (top), 94, 95 (top)
Steenkamp, Theuns 35, 209 (top right)
U.S. Military 237, 241, 242
Van Heerden, Jaco 134, 135
Van Rensburg, Erich 208, 209
Victor, Pierre 60 (bottom), 81 (top right), 102 (bottom left), 103 (bottom left), 104, 114 (bottom), 159, 165, 177, 182-184, 188-191, 233 (bottom left), 240 (top)
Webb, Pete (Sandstone) 33, 92, 93

Steve Camp is an officer in the SA Army reserve force and holds the rank of a lieutenant-colonel. He was the officer commanding 15 Maintenance Unit for ten years. During his military training Steve qualified for his paratrooper wings and has since trained with and been awarded the military airborne wings of Israel, Burma, Estonia, Cuba and America. As a young officer in the 1980s, he has many memories of driving the Buffel and Kwêvoël and travelling in the Casspir in various operations during the Border War, where he was struck by how the engineering and design of these vehicles worked to save lives. Steve describes himself as a social sportsman who loves adventure. He has reached the summits of four of the world's highest seven continental peaks: Mts Aconcagua, McKinley, Kilimanjaro and Kosciusko. He is one of only a handful of people to have competed in all five of South Africa's 'Big Five' events: ten Comrades Marathons, 13 Duzi Canoe Marathons, ten Argus Cycle Tours, 16 Midmar Mile swims and one Cape to Rio Yacht Race. He is also part of an elite group of international runners to have run a marathon on all seven continents, namely, the Great Wall of China, London, Inca Trail, New York, Sydney and the Antarctica marathons. Steve was a member of the South African teams that competed in expedition adventure races in the Raid Gauloises in Ecuador and Vietnam and the Eco Challenge in Patagonia. He led the six-week African Powered Paragliding expedition flying a motorised paraglider from Kilimanjaro to Victoria Falls. He has also successfully completed the Roof of Africa Rally in Lesotho on a motorbike. While living in New Zealand, Steve seta Guinness World Record for the longest distance travelled in a Zorb. Steve is heavily involved as a volunteer in the Scouting movement of South Africa in a leadership capacity, as he finds this combines his love of the outdoors and adventure with his desire to give back to the community. Steve is the author of 17 books, holds a Bachelor of Education degree and lives in Hillcrest outside of Durban with Sally and their two children, Sarah and Stuart.

Helmoed-Römer Heitman has written and lectured on defence since 1978, consults to the Defence Ministry, Defence Force, parliamentarians and defence companies, and edits the *South African Army Journal*. He served in the SA Army reserve from 1970 to 1996, in posts from LMG team leader to brigade intelligence officer, sector and command duty officer, and finally as a studies officer in the Long-Term Planning Division at Defence Headquarters. He worked with non-statutory forces and political parties from 1991 in the run-up to the 1996 Defence White Paper, served on a working group of the 1998 Defence Review, and with the SA Army's Vision 2020 team as well as developing a new staff system. He has worked with the Navy on fleet design concepts and the potential of multi-role vessels, and the Air Force on force design and operational employment doctrine for the Rooivalk Attack Helicopter. He served on the Resource Group of the Defence Review Committee from 2011 to early 2013. He holds economics and public administration degrees from the University of Cape Town, an MA in War Studies from King's College, University of London and management diplomas from Stellenbosch University's Graduate School of Business, and passed the junior staff course of the SA Army College. He has written six books and four minor titles on defence matters, drawn up more than 120 papers and studies, presented papers at more than 60 defence conferences and published more than 500 articles on defence matters in South Africa and other countries.